SENIOR COUNTRY READER

II

BY

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JOINT-AUTHOR "LESSONS ON COUNTRY LIFE"

WITH ILLUSTRATIONS

No. 66

To force the soil to produce its best and help the animal to live its best, is noble work.

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PREFACE.

I THINK that we are all agreed that one of the most important items, if not the most important item, in Primary Education is to teach a child to read to itself with intelligence, and to read aloud to others, in a distinct, fluent, and pleasant tone of voice.

It makes reading so much easier for the Teacher to teach, and for the Children to learn, if the reading matter is on a subject that naturally interests the children's minds, concerning things which they can observe for themselves every day of their lives, and which may be of some practical use to them in their future life.

Not by a set form of lessons learnt parrot-like, so distasteful to the developing young mind, but by observation and reading, supplemented by short talks with an enthusiastic teacher, is surely the wisest method of interesting the children in the beauty and wonders of the country, and of impressing their minds with the nobility of all work that helps the animal to live its best and the soil to produce its best.

This is especially true for those children who intend making the land, either in this country or over the seas, the sphere of their coming work, and the place of their future home.

True also, in a lesser degree it may be, for those children who intend seeking work in populous centres. For at times—and in the future I think, with shorter intervals—the town workers will seek the fresh air and ample space of the country, to rest and restore health to their minds and bodies. When they do come amongst us, if they recognise an old friend in the stretch of land, and in the life of animal and plant, which the *Country Readers* have spoken to them about, how much keener will be their observation and sympathy, and therefore how much more enjoyable and health-giving will be their visits.

I have hopes that in this country the good time may come, when the majority of honest working families throughout the land will own some head of live stock, and grow some crop for use and pleasure.

I am indebted to Mr. Martin Sutton for the help his work, "Permanent and Temporary Pastures," has afforded me; also to Messrs. James Carter & Co. and Messrs. Sutton & Sons, for the use of many of the beautiful and valuable illustrations of grasses.

H. B. M. BUCHANAN.

HALES,
NR. MARKET-DRAYTON.

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A COUNTRY READER.

II.

THE GOAT.

In the present state of agriculture, when foreign competition is so keen and prices so low, it is important that nothing should be wasted, but that everything should be made the most of and put to the best use.

Every yard of ground, at the lowest outlay, must be made to produce the most suitable and largest crop.

Every animal must be bred, fed and tended, so that it returns its best, whether that return be in milk, flesh, or hide.

This is the secret of successful farming.

The cottager undoubtedly could make a profitable use of the goat. Why then do we so seldom find the goat in the country districts?

Years ago a goat was much more often seen than it is now, and for the following reason.

Formerly there were many more open spaces and wilder country lanes, where the goat could be tethered without disturbance. But better kept high-roads, and more carefully trimmed and ditched lanes, have in many cases rendered the keeping of a goat an impossibility.

Goats must be tethered, because owing to their activity and power of climbing, no hedgerow or wall will keep them in. In many districts it is against the law to tether an animal without an attendant.

Still there are many places where a goat could be tethered, and kept to the cottager's profit.

Plots of waste ground that are waiting for bricks and mortar, sides of railway banks, and the slopes of almost barren hills—in fact, almost any place that is too rocky, or the herbage too poor to maintain cattle and sheep, will keep a goat in health.

If the authorities will permit it, many of the lonely wayside lanes, with rich and abundant keep on either side of the road, would be a paradise for a goat. You must have noticed how rich the herbage is on either side of the roads and lanes; especially rich is its growth of white clover. This is owing to the manured dust and scrapings of the road or lane finding their way over the grass.

If goats are kept they must be tethered, be-

cause of their wandering and destructive habits, and moreover they give more milk when tethered than when allowed to roam. They will nip the tops of the hedges, destroy young trees, and so damage and ruin plantations. So destructive is the goat, that in many places where they have been kept in numbers—as has been the case around the Mediterranean Sea—they have completely destroyed the forests and trees of the mountain sides, and as the rainfall depends much upon the presence of trees, the goats by destroying them, have considerably lessened the amount of moisture (which has never been too abundant), of these districts.

The tether should be attached to an iron pin, which can be driven into the ground. To the head of this iron pin is attached a swivel. The swivel allows the chain to work freely, and thus prevents the chain from becoming entangled.

The iron pin should be shifted two or three times a day, in order to allow the goat to browse upon fresh herbage.

A goat tethered in this manner, will with the addition of a few pence spent per week on corn, supply a whole family with good milk.

Particular attention should be taken when cooking the milk of the goat, as owing to its richer composition it is more given to curdling than the milk of the cow.

It is an acknowledged fact that the best food for children up to the age of four or five is milk, and that the healthiest children are those who, for the first four or five years of their lives, are fed principally upon it.

But to obtain milk, in many parts of the country, is difficult.

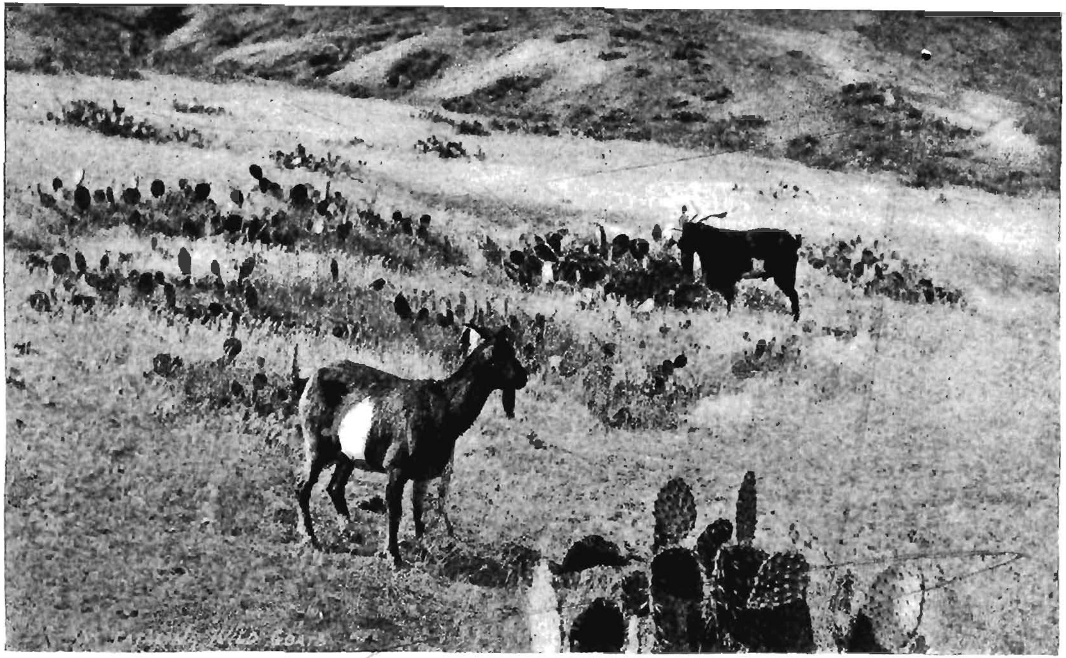
In the dairy districts the farmers require all their milk, either for making cheese and butter, or for carrying out their contracts, to supply a certain quantity of milk each day, to the milk-buyers of the populous centres.

In the feeding and grazing districts, the farmers naturally do not produce any milk over and above their own family requirements.

Therefore, the importance of keeping a goat, whenever possible, if only to supply the children of the cottagers with a nourishing wholesome food.

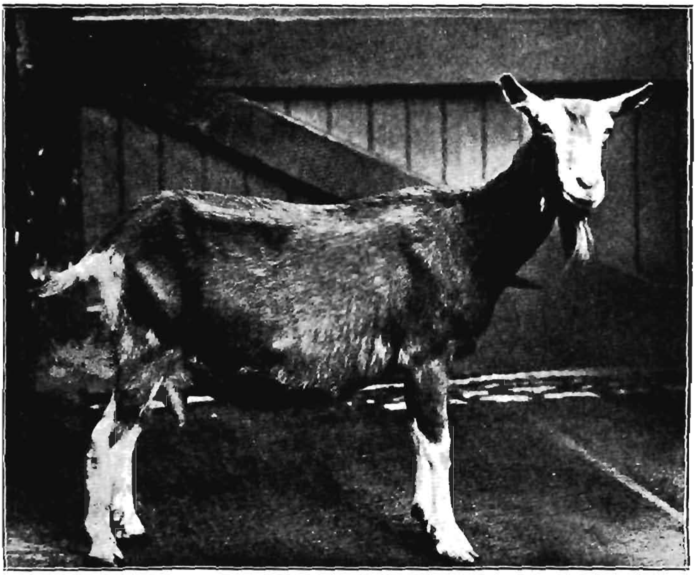
Goats' milk is much more easy to digest than cows' milk, and is therefore very valuable for children and invalids.

It is nourishing, and less acid than cows' milk, and about half as rich again both in cream and other solids. The cream is more finely divided and will not rise so readily, and is quite white, for which reason some people suppose it absent. The cream makes the milk delicious in flavour, and if separated it can be made into good



WILD GOATS.

butter, which is also pure white. Some goats will yield over three quarts of milk daily; but the more important point is the continuance of the yield. The Toggenberg goat is the best in



TOGGENBERG GOAT, "Sedgemere Celia."
The property of Mr. S. Woodiwiss, 1st prize, Dairy Show, 1907, Agricultural Hall, London.

this respect. This strain comes from a valley in the Alps, where for centuries it has undergone selection as a milch goat. A good Toggenberg will give more than twelve times her own weight of milk in the year.

A good milker may be known by these features:

prominent eyes, sharp ridge to the nose, with hollow cheeks. Withers high and sharp, with wide hips. Well rounded ribs, and deep body, especially towards the udder, which should be well developed, soft when empty, and with large teats. The whole frame lean and bony. The goat should look alert, with bright eyes, a moist nose, and should have a good appetite. One that feeds badly, or is slab-sided, is of little use.

No animal is more cleanly than the goat, and its food should be scrupulously clean. It is a common mistake to suppose that they smell; the strong odour is only found in the he-goat, and even in his case is slight during half the year.

Any outhouse, provided it has a water-tight roof and is well ventilated, will house a goat. The animal is very hardy and suffers from very few diseases.

A goat brings forth two and sometimes three kids a year, generally in the month of April.

A goat is at its best between three and six years old.

The skin of the kid is made into gloves. Lamb-skin is often used for this purpose, but the kid-skin is of firmer grain, closer together, more elastic than that of lamb-skin, and therefore makes a glove of better shape and fit.

A goat is closely allied to the sheep, but is

distinguished from the sheep by its horns which are placed well on the top of its head, and curve backwards along each side of the spine, also by its arched forehead, its straight nose, and bearded chin, its short erect tail, and strong smell.

A goat has a quick sight and keen smell, and is swift in flight, but is very brave in attack and defence. The animal is very clever in climbing amidst the most dangerous rocks and precipices, which fact has developed its calm and steady nerves.

In many countries of Europe the goat is called the poor man's cow, and is much more extensively used than in England, the reason probably being, that the more scanty herbage of these countries will support a goat in better condition than it will support a cow; and moreover, the lighter milk of the goat in hot climates is more wholesome to use than the heavier milk of the cow, which is better adapted for the colder climate of England.

In the hot Eastern countries the goat is led round from door to door, and the milk that each householder requires is taken from the animal there and then—a very effectual method of making sure of obtaining unadulterated fresh milk.

Habits and Nerve.

If the goat escapes from control it soon resumes its wild ways and appearance, and reverts back to the wild ways of its forefathers, —reversion to type, as it is called.

The goat in a wild state lives on high mountains, amongst precipices and broken crags, and therefore if it were to live and not to die, it had to develop a hardy nature and live on the herbage it found around it. This herbage principally consists of scanty and poor grass, fallen leaves, twigs, and scattered shrubs.

But these shrubs are very different from those of our more temperate climate.

The hot sun of the East, where the goat was originally found, has developed shrubs and growths that have a marked bitter and aromatic flavour. These shrubs have developed their bitter and strong flavours to defend themselves from being eaten by the animals that wander amidst these sunlit, high, rugged places. In fact just as the goat has developed horns as a means of defence against its enemies, so these shrubs have developed their strong and pungent flavour as a means of defence against their enemies.

But if the goat were to live and not to die of starvation, it had to develop a liking for and

to thrive on these strong flavours. This the goat through generations of its wild life has accomplished. The domestic goat has inherited this taste for strong flavours, and has also inherited the hardihood of its wild ancestors. This is one of the reasons why a goat will live and thrive under conditions where every other farm animal would starve and die. It will practically pick up its own living and require little attention.

The goat will eat wormwood, and even hot chillies, and many other vegetable substances that no other animal will touch.

In consequence of the habits which the goat has inherited from its wild ancestors of the mountains, it has developed extraordinary powers of climbing and jumping, with strong nerves and remarkable presence of mind.

The ass is a fellow-mountaineer with the goat, and both these animals have the steadiest of nerves.

Sheep, oxen, pigs, and horses on being frightened will easily lose their heads, be seized with a panic, and gallop wildly about; but not so the goat.

There is nothing that terrifies a horse more than a fire. So paralysed with fear does the poor beast become, that if his stable is on fire while he is in it, as a rule he has to be blindfolded before he can be led out. So when fires

were more numerous than they are now, it was the custom to keep a goat in the stable, so that in case of fire the goat, with his steady nerve and presence of mind, might give the lead out of the burning stable to the frightened horses.

Cattle have a horror of the butcher's slaughter-house. They seem to have the power of smelling the blood. So butchers have at times great difficulty in inducing the animals to enter their premises. Many of them therefore keep a goat to give a lead and restore confidence to the frightened cattle.

Intelligence and Climbing.

Goats are possessed of great intelligence, and this intelligence has been utilised in unloading cattle ships. They will go to each part of the ship where the sheep are penned, and lead the way over the gangway. And you all know how readily sheep will follow a leader.

In consequence of the wild goat living its life on the heights, it has developed wonderful powers of sure-footedness. Where a sheep will jump, a goat will clamber; hence some of the difference in shape between a leg of mutton and a leg of goat.

To enable the sheep to jump, the muscles of the leg are full and large.

To enable the goat to clamber, the muscles of the hind legs are lean and tight.

To show the great natural intelligence of a goat, it is recorded on the best authority that two goats met on the narrow ledge of a precipice, where there was no room for one to pass the other, so one goat deliberately lay down while the other goat stepped over him. That was a piece of intelligence, a bit of reasoning of a high order, an adapting of a means to an end. The means was the lying down of one goat so that the other goat might step over; the end, the goats continuing their journey without harm to themselves. It also proved the wisdom of mutual help, for had they fought for the possession of the narrow ledge, the probabilities are that one, if not both, would have lost their lives.

To show you the extraordinary climbing power of a goat, one careful observer says that he once saw a pair of kids running races up and down the shafts of a disused farm roller, tilted at an angle of 45°. When they reached the extreme end of the shaft, lifted high up in the air, the little, steady-headed creatures would bring the tips of their little hooflets so close together that they would almost rest on a penny piece, and then very slowly turn themselves round, as on a pivot, and slowly descend the

shafts. A little kid is a delightful companion for a child, very lively and very clever.

By noticing the ways and doings of our domestic animals, what they eat, how they eat, their natural attitudes and ways, and their play when young, we are often able to learn what the surroundings were like, amongst which their wild ancestors lived, before they were domesticated by man.

For instance, the steady nerves of our ass and goat tell us, that their wild ancestors must have lived where the surroundings called for the keeping of a cool and steady head.

What conditions would more demand the constant exercise of the steady nerve and head, than life amidst mountainous regions?

We know that the ass is fond of thistles, and that the goat is fond of strong, pungent flavours, and that both animals will thrive on food upon which other animals would starve, and that both animals are very hardy and of a good constitution, seldom requiring the veterinary surgeon.

These are the conditions, and the surroundings that exist, wherever the wild representatives of our ass and goat are found.

THE DONKEY.

Extinct Ancestors.

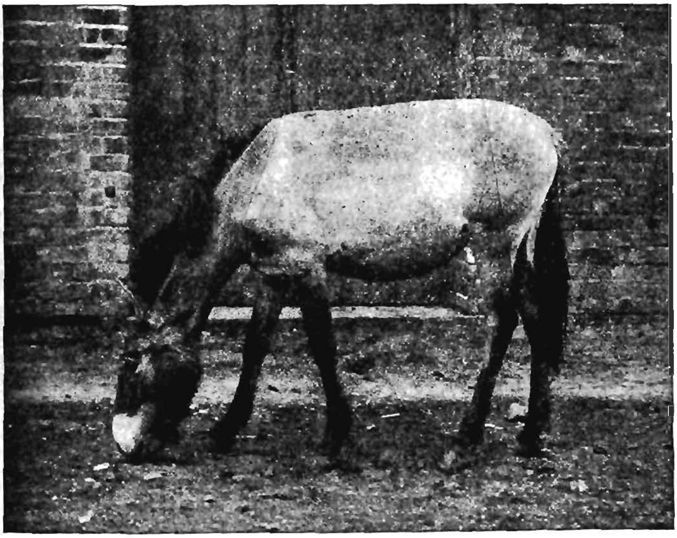
THE ass is a first cousin to the horse, some authorities go so far as to state that the extinct ancestor of the horse was of an ass-like appearance.

The Hipparion is the name given to a remote and extinct ancestor of the horse. This horse-ancestor moved about on one toe, or hoof, similar to the horse of to-day, while two other toes, or hoofs, one on each side of the toe that touched the ground, hung suspended on either side. In the modern horse these two suspended toes have disappeared, and except to the horse-man who knows where and how to feel for splints, they are not recognised.

The fossilised bones of these Hipparion horses, which at a very remote period must have wandered wild in very considerable numbers over the plains of the world, have been found here and there, and have been pieced together by scientific men, who have given a life's study

and work to this very difficult science—the science of Palaeontology as it is termed.

The gathering together of these fossil bones, and fixing them in our museums in forms similar



WILD HORSE CAPTURED IN CENTRAL ASIA.
3½ years old, between 11 to 12 hands high. In summer coat. The winter coat is very thick and blanket-like, and the dark stripe along the centre of the back is then strongly marked. Note the ass-like character of the tail, short forelock, mane, and hoofs.

to the animals that once lived, has proved without doubt what the bony formation of these Hipparion horses was like.

But the fossil forms can tell us nothing of the colour of the coat, and general appearance of the animals themselves.

Nevertheless, from the appearance of the wild horses and wild asses found living to-day, and from other evidences, the Hipparion wild horses are thought to have had some very ass-like characteristics; in fact, more ass-like than horse-like.

The wild horses, that have lately been captured in Central Asia, and now to be seen in the Zoological Gardens of London, have certainly some ass-like characteristics—the feet, nostrils, tail, and the stripe down the back are certainly ass-like. In fact, their general appearance struck the writer as strangely mixed between the ass and the horse. They are said to be the first genuine wild horses that have ever been captured. The *so called* wild horses captured previously to these, are now said to have been horses that at one time were domesticated, which escaping from captivity, have reverted back to their wild condition.

Interesting as these speculations are concerning the extinct ancestors of the horse and ass, we cannot go further into them, but must confine ourselves to the living wild asses found to-day.

Wild Asses

wander to-day over the arid or dry and parched regions of Asia, ranging from Syria to Persia and Western India, and northward over a large extent of Asia.

These wild asses are of moderate size, with rather long tails, standing from 3 feet 8 inches to 4 feet—11 to 12 hands at the withers.

The wild Asiatic asses, male and female, to be seen in the Zoological Gardens, London, are really beautiful creatures, whitish brown in colour, with smooth coat, alert and slender but strongly built, with hard bone. They seem to bear this climate well, for this pair have been in the Gardens ten years, and they are now in the pink of condition. Why are not these asses imported and used in this country? They would be very ornamental and hardy, and might be made most useful.

There are three varieties of these Asiatic wild asses, some varieties being larger than others.

They travel over great desert plains and stony ground, and when pressed they travel at a great pace, and with a remarkable security of foothold. They mostly live in small bands of two to four or five, sometimes in herds of twenty to thirty.

They feed, and keep in hard condition, on the dry wiry grasses, the only growth of those arid regions.

Like many of the fleeter animals that live where vegetation is scarce, they are often obliged to wander for long distances in search of food.

This migration in search of food may be one

reason for the remarkable endurance of the modern horse and ass.

The natural pace of the wild horse and ass, when travelling, is said to be a trot, hence the ease with which the domesticated breed can keep up this pace for long distances.

Certain species of the wild ass are very inquisitive, approaching within forty or fifty yards of the traveller, while others are very wild, and so fleet of foot, that a man on a good horse finds it difficult to ride them down. Their bray is said to be something between the neigh of a horse and the bray of a common donkey. Their keeper in the Zoological Gardens says that it resembles the bray of the zebra. It would be interesting to find out what were the different conditions that made one variety of wild ass a shy animal, and another variety of ass an inquisitive animal. There is a reason for everything, if we can only find it out. To search for causes is perhaps one of the chief objects of study and knowledge, it is certainly one of the most interesting.

The shy variety may have been more subject to the attacks of beasts of prey, and the hunting down by man, and it may have been rendered more nervous by disturbances of nature, such as earthquakes and storms.

The inquisitive variety, on the other hand, may have lived in comparative security, and

may not have been subjected to so many of these frightening agencies.

The African Wild Ass

has perhaps the most interest for us, because our domestic breeds are said to have descended from it. There is certainly a very close similarity between the African ass and the domesticated ass, and their bray cannot be distinguished one from the other.

The Ass was domesticated by the Egyptians before the horse, and was used as a servant by that wonderful people in the valley of the Nile, and from thence, by means of the great Roman conquests, it gradually spread over Europe.

In the desert regions of Africa, in the mountainous tableland to the south and east of Egypt, and in Somaliland the wild African ass is found to-day. It has much larger ears, a shorter mane and tail, and has a thicker coat than the wild Asiatic ass.

Travellers who have seen the African ass wandering at will, tell us that in its native haunts it is the perfection of activity and courage, and that as it travels with the speed of the horse, over the rocks and sands of its native country, it carries itself well with an all-round free action.

It is very difficult to approach, and it keeps

fat and in good condition on the wiry and scanty herbage that it finds to eat.

The colour of these wild asses matches so wonderfully with the rocks and sands amidst which they wander, that it is at times very difficult to see them. This "protective coloration," as it is termed, must have often saved a wild ass's life.

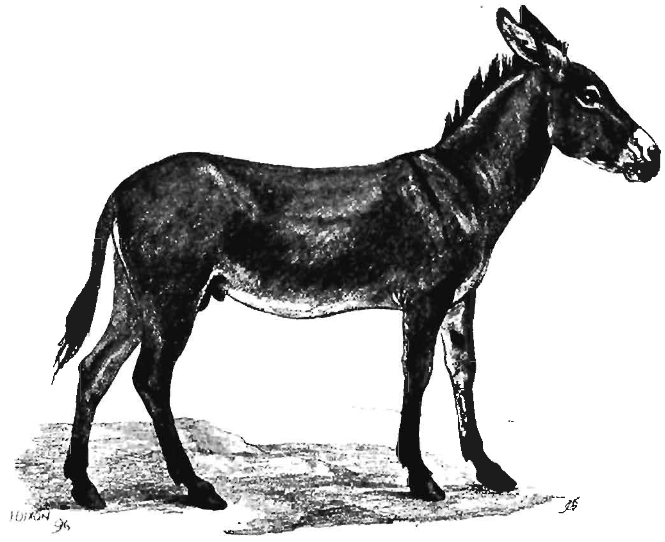
During the long past, only those wild asses had a chance of living and rearing offspring, whose colour was such as would help to conceal them, and who by their keen eyesight, quick hearing, and general alertness could detect an enemy approaching, and then, by hard stamina and quick pace, could make good their escape.

If we observe and reflect upon the formation of a horse's foot, its strength of leg, its speed, its alertness, its keen eyesight, its proneness to shy, its manner of getting up from the ground, its sociability, its endurance, especially when trotting, its thriving upon dry hard food, we are led to believe that the ancestor of the domesticated horse lived in herds on open, extensive plains where water was scarce, and where the herbage was wiry and scanty.

The wild horse, it is thought, took to these open plains, to escape from enemies that lurked in the forests and jungles of the swampy lowlands. It is thought that for the same reason

the wild ass was driven into the wilderness, but it was a wilderness not so open, abounding more with mountains and hills.

In order to understand how certain characteristics of the horse, and the ass, became fixed, it is



THE AFRICAN WILD ASS. ($\frac{1}{20}$ Nat. Size.)

important to try and realise the following facts. The wild ancestors of the horse and of the ass, must have wandered at will over extensive tracts of uncultivated, and diversified country, long ages before they were pressed into service by man.

During this long period, if they were to survive, they had slowly to acquire certain

characteristics, physical and mental, which were the most suitable to the wild life they had to lead.

They had to wander long distances in search of their scanty food, they had to rear their foals in safety. They had to guard against the crafty, stealthy, stalking, and hunting of their ever-vigilant enemies, the beasts of prey. They had to keep sound and in good condition, in different degrees of climate, and on very scanty fare.

To perform, and to survive all this, certain mental and physical characteristics had to be acquired, and then further, by constant habit, to become fixed or instinctive.

The characteristics needed were alertness, speed, and endurance, and in the case of the horse, mutual self-help, and the essential characteristic of being able to keep themselves in sound, hard condition, amidst constant changes of climate, and on scanty dry and wiry food.

And those asses which did not possess these habits of self-preservation so perfectly, fell victims to the numberless dangers, leaving the healthiest, the keenest, and the wisest to survive.

Just consider an almost every-day occurrence, to illustrate this important principle of the workings of a natural law.

A great lake, or river often fills but very

gradually ; it may be most of us see no difference, so long as its rise is very slow, and it is kept within its natural boundaries.

One day a catastrophe takes place, and we say the catastrophe is sudden, but the slow trickling from hill and mountain side has been running very gradually, it may be for a long period, towards the final flood.

To obtain that wonderful eye, that keen hearing, that well-knit-together frame, that straight whip-cord kind of leg, what lives it must have cost the race of wild ancestors of the ass.

We must believe that it cost the lives of numberless animals, and the survivors many generations of experience and inheritance to fix the essentials of ass preservation, but at last so firmly fixed have they become, that man by his domestication has altered or modified them but little.

To take the wild traits as man found them, and then to develop them along their natural lines, so that they might be of the greatest service to him, was the wisest plan, and this plan he has adopted, hence the great use these animals are to him.

Horse and Ass Compared.

Now notice these points about the donkey, and then reflect, if they do not incline one to believe

that the wild donkey lived in more mountainous regions, than the wild horse.

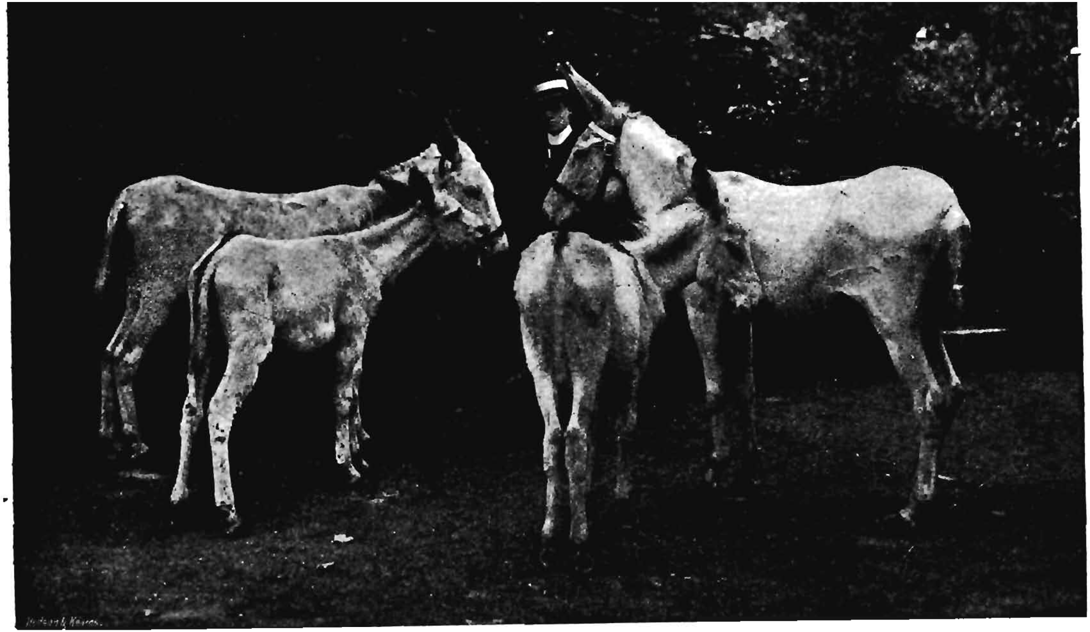
A donkey is very surefooted, and if he chooses can climb up and down hillsides, with as sure a foothold as that of a cat.

The writer has ridden on a donkey, with his legs almost touching the ground, up and down an almost perpendicular mountain side; and its accuracy of foothold, and the strength of its thin legs were really marvellous.

The legs of the donkey are very similar to those of the Bighorn chamois, and other climbing animals. They are strong and sinewy like whipcord. A donkey's foot is more pointed than that of a horse, similar in shape to those of other hoofed animals that live in mountainous regions. In consequence of the wild ass's mountainous life, our modern donkey has excellent nerves and is not given to shying, or to be seized with panic, and it never loses its head on the most perilous track, which can not be said of the horse.

Horses that come from a very open country, such as the Arab, and Barb horses, are not nearly so addicted to shying, as those that live where, here and there, are scattered clumps of bushes and trees, which might harbour an enemy.

Now for long ages, the wild ancestors of the ass lived where there was comparatively little



IMPORTED WHITE ASSES.

danger of its enemies lying in ambush. This may account for the ass's steady disposition, and his inclination not to shy. But although he had not over-much fear of his enemies lying in ambush, he was always on the alert, against their wary approach and clever stalking, that the projecting crags around could so easily conceal.

The clever, crafty Beast of Prey would creep and pause, and lie still, taking advantage of every bit of cover, until it crept within the distance needful for a successful spring. Therefore the importance of a donkey having large ears to catch quickly and readily any sound that might be made by his approaching enemy.

The ass is grey in colour with a black band down the back, a most suitable coloration for concealing a wild ass from its enemies. The grey tint of the ass would exactly match with the greyness of the mountain and its surroundings, and so he would have a better chance of escaping notice, than if he were of a colour that would stand out clear and distinct, against the rocks, hills, and sandy-coloured soil, that everywhere surrounded him.

A donkey's coat is more shaggy than that of a horse. This suggests that the wild ass lived in elevated regions where the air was cold, at the same time a donkey can bear heat well. This again suggests that his original wild home was

amidst the mountainous regions of the tropics, where he was subject to variations of temperature, sometimes cold, sometimes hot.

The eyes of a donkey are said not to be so quick as are those of a horse, nor does he so often turn his head about to sniff the air.

On sandy or grassy plains where the wild horse wandered, sound is deadened, and therefore eyes are more valuable than ears, to catch sight of any approaching enemy; and the breeze blowing evenly across the plain reveals to the horse, if he be standing to leeward, the approach of an enemy before it comes in sight.

Another natural trait observed in the ass is its inveterate dislike to crossing water. With some asses this is so strong that no coaxing or bribing will get them over.

How is this to be accounted for, except that the wild ancestors lived in districts where they had little or no experience of water?

Some horses also have a strong dislike to open water, as many a hunting man has found to his cost, when a piece of open water that requires jumping, lies between him, and the line that the hounds are taking.

Another trait—an ass has a great liking for thistles, and its mouth is so made that the prick of a thistle has no effect upon it. This fact proves that the wild asses must have lived

in regions where the thistle family of plant abound.

The Stubbornness of an Ass.—A Suggestion.

A donkey is not a sociable animal, nor has he the small talk and pretty calls of a horse. Go into a horse's stable and if he has been treated kindly, he will whimper to you as much as to say, "I am glad to see you, have you my lump of sugar?" But go up to a donkey and he will probably take no notice of you.

Horses are particularly fond of being together, they are perhaps the most sociable of all our animals, but not so the ass.

In mountainous places where food is scanty, only a few wild asses could live together; while, on the other hand, wild horses who lived in more level districts, where food was more plentiful, could herd together in greater numbers. Should a foe appear, each ass must decide for itself how best to escape, *no following* the leader and making good an escape in that manner. May not this have developed in an ass a stubborn self-reliance.

You must have noticed that people who live somewhat isolated lives are more stubborn, more self-reliant, less quick to act, than people who live in communities, who act together, and ask advice of each other.

The isolated life of the wild ass, when compared with the wild life of the horse, may have produced its natural stubbornness, but the stubbornness has without doubt been intensified, by its cruel ill-treatment, at the hands of the people of this and other countries.

It is the only one of the farm animals, that man by his stupid treatment has caused to degenerate.

Horses, cattle, pigs, and poultry by wise treatment, feeding, and housing, have become more serviceable to us. The ass on the contrary has become less serviceable to us, and this is the revenge he has taken for his treatment.

And yet the ass by its power of endurance, its hardihood, its being able to live and thrive on food that would starve a horse, ought to be of the greatest service to us in the country.

The Use of the Ass.

Many a useful job a willing, surefooted, quick-trotting ass could perform. Especially valuable would it be to the Small Holders. On market days, in a well-balanced, suitable, two-wheeled cart, it could carry the eggs, butter, spare fruit, and vegetables, to the nearest market. It could fetch the bags of coal, it could cart the manure on to the bit of grass-land, and do many other useful jobs. It might spare the old

villager, the painful trudge on market days of carrying on the arm the heavy basket containing the household necessaries for the week.

A good ass can be purchased for about £4, whereas a strong sound pony would cost between £15 and £20.

The cart that would suit a donkey, can be built at less cost than a cart that would suit a pony.

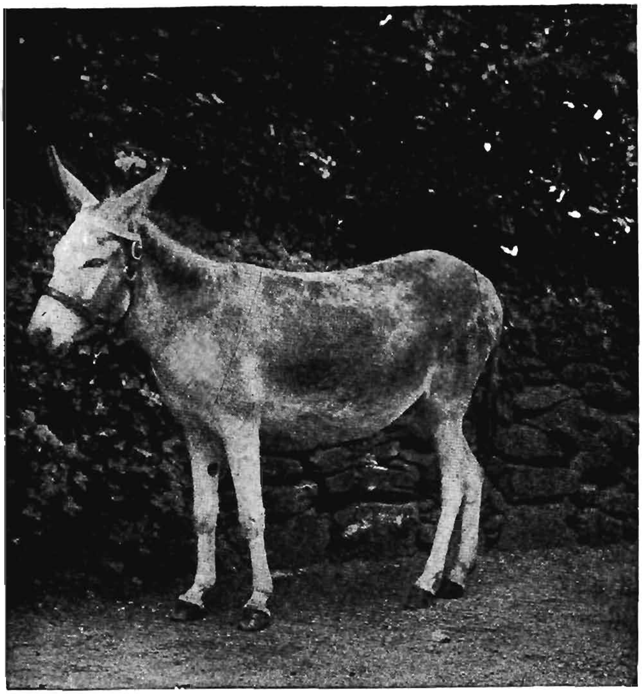
Donkeys are contented with the leavings of the cattle, and will thrive on thistles and tufts of rank and bitter grasses.

In the present state of keen foreign competition, when everyone in the country, under the best conditions has to work so hard, and to manage so wisely, to make a living—such considerations ought to weigh, especially with the villagers and small holders, in deciding whether a pony or a donkey is to be kept.

Not only can donkeys be purchased, and kept at a much less cost than ponies, but in proportion, they are more muscular, can stand exposure to every variation of climate better, and they are much less subject to disease. They live longer, their duration of life being forty years.

Asses are mostly, in this country, in a deplorable condition, because of habitual cruelty, bad feeding and general neglect. But with reasonable breeding and care, there is no reason why

they should not be considerably improved. Their small size is probably due to rough treatment and bad food. In Spain, the United



THE DONKEY.

States, and in Eastern countries, they have reached a height of from 14 to 16 hands. Owing to the care and wise treatment they have received in these countries, they have lost a vast deal

of their stubbornness, and do the work required of them equally well, and as willingly as many a horse or pony.

Even in this country a well-cared-for donkey can occasionally be seen trotting along as merrily as the best pony.

The writer has often seen in London, a coster's donkey cart, the coster himself and a good load inside, keeping pace with his hansom cab without the need of whip or stick.

It is a little difficult to understand why the donkey has received such foolish treatment, at the hands of the English people.

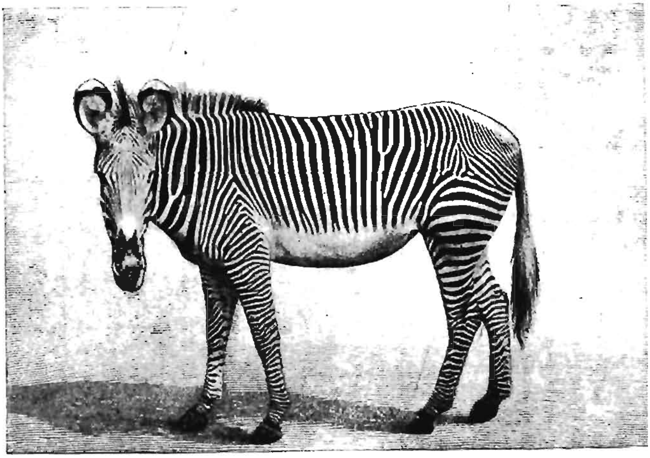
Such treatment has intensified all its natural stubbornness, and has increased tenfold all its worst traits, the result being that the donkey has degenerated in all respects.

How to Improve the Race.

The present race of donkeys can hardly be improved, their ill-treatment has been too long continued. The best plan for the future would be to breed from donkeys which have been treated well, and which are willing to work, without the horrible blows, and thrashings, to which we too often see them subjected.

Rear the foals from this line of descent and break them in to work, with the same kindness, firmness, and study of their individual characters,

that a wise horseman should employ in breaking in his young horse. Feed them on food that they naturally thrive and do well on, with a small daily allowance of corn. Keep them clean, and curry-comb and brush them over every morning. If some such system as this were adopted in dealing with donkeys, we should soon have a race of animals amongst us of the greatest use to the workers in the country, and a race of animals that would cost less to buy, rear and keep, than any other animal that we use to do the work of the farm, especially the work of the small Farm Holder and the Village Cottager.



THE ZEBRA.

In the Zoological Society's Gardens, London. The call of this animal is a sound between the neigh of a horse and the bray of a donkey.

THE TIGER (a large cat).

THE CAT.

THE domesticated cat is a most useful animal, and an animal we could not dispense with, without much loss to the community.

Perhaps there is no devastation more appalling to the farmer than a plague of rats, mice, and voles. The cat not only kills a number of these pests, but its very presence tends to keep them away from the houses and buildings where they are kept.

If a house is beset with mice, the introduction of a cat, if she be a clever mouser,—the mice soon know if a cat is a clever mouser or not,—will soon

effect a clearance, the mice thinking it wiser to go elsewhere.

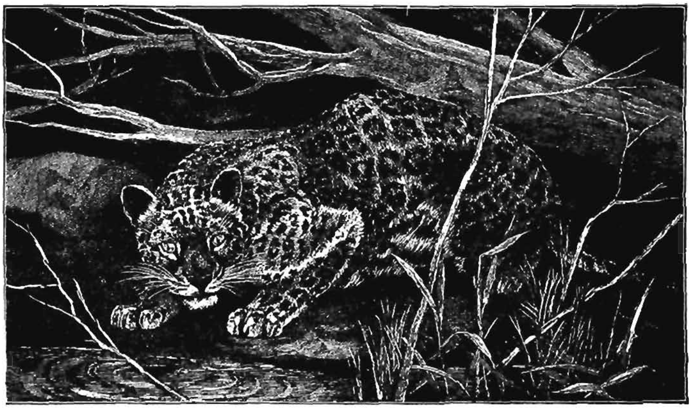
If the yearly sum that is lost by the devastation of rats, mice, field voles, and the undue multiplication of house sparrows, could be reckoned, it would amount to a very startling sum.

If food is scarce in one district, or on one farm, rats, mice, and voles, will migrate to places where it is more plentiful, hence the need of combined action on the part of all farmers to keep these pests under. There is not much permanent use for the intelligent farmer of a district to keep down the rats, mice, and voles on his farm, if the neighbouring farmers do not do the same. These vermin spread like thistledown.

Owing to the rapid lessening of the animals and birds of prey, such as the Stoat, the Weasel, the Owl, and the Kestrel Hawk, the writer is convinced that the vermin on the farms are rapidly increasing in number, and unless some concentrated action is soon taken, the results will some day be very serious.

If vermin are to be kept in check, it is essential that a few good cats should be kept about a farm. Not the highly-bred cats that hardly know how to catch a mouse, and will not face a rat when they see one, but the cats that come from a good strain of mousers, and are noted for their pluck,

and indefatigable hunting powers. These cats are often lean, underbred-looking animals, somewhat wild in their habits, but certainly the best for the object in view. Such cats have the old wild hunting instincts strong within them, so they are often desperate poachers after game, and in



THE LEOPARD (a lesser cat).

consequence fall victims to the gamekeeper's traps and guns.

The writer has known several farmers lately, who have given up keeping cats, because they are always being destroyed in this manner.

The Cat Family—Distinctive Characteristics.

Lions, Tigers, Leopards, Jaguars, Pumas, Lynxes, and the smaller species of Cat are all included in the great family of the Cats. All this

family eat flesh, and are therefore called "carnivores." Their long, lithe bodies, which combine strength, suppleness, agility, and quickness, are adapted for the pursuit and destruction of their living prey. Their strength and suppleness, in proportion to the weight of their

Compare the markings on the big cat's (tiger) skin and the markings on the kitten.

body, is so great, that they are able to drag down, and kill animals of far greater weight and bulk than their own. In proportion to their weight, there is probably no animal so strong and supple as the members of the cat family.

They are noted for the shortness of their hair, and of their muzzle; their fangs, or teeth, are very powerful, and their claws work in a sheath, which

acts as a protection, and can be drawn in and out at will. They have five toes on their fore feet, and four toes on their hind feet.

All the cat family walk upon their toes, and are therefore called digitigrade animals. The hind part of the foot is entirely raised from the ground to form a combination of the leg.

The stealthy and noiseless walk of the cat is due to soft cushions or pads on the under surface of the foot; each toe has a separate pad, and behind these toe pads, they have a large main pad, which occupies the middle of the sole of the foot. The fore foot is furnished with six, and the hind foot with five foot pads.

Could any formation of foot be more suitable to allow the great Cat family to crouch, to lie still, to rise and stalk their prey with rapidity, without jerk or noise, than this?

You can distinguish the impression, or spoor of the cat, on any ground that will receive an impression, because that impression shows only the form and number of the pads, but shows no mark of claws, because the claws are always withdrawn into the sheaths when the animal is moving about.

A cat only ejects its claws out of their sheaths when it is attacking its prey, or when its anger is excited. A dog's spoor or impression, on the other hand, shows not only his pads, but his

claws, which are not withdrawn into sheaths, but are always fixed in the same position.

PERSIAN KITTENS.

A cat's tongue is very rough and like a rasp. This enables it to lick the meat from a bone, and to clean its fur so effectively. This may be a reason why the fur of a healthy cat is so much cleaner, and smells so much sweeter, than

the coat of the average dog. A dog's tongue is quite smooth.

The teeth of a dog are adapted for cracking and breaking bones, which are then gulped down and assimilated by a stomach especially suited for that purpose.

On the other hand, a cat's teeth and stomach cannot do this, and so the bones of their prey are licked clean by their rough tongue, or if the bones are soft they are ground into small pieces before entering the stomach.

Their fur is usually short and suited for bearing either cold or heat.

The tail is long and cylindrical, and capable of movement from side to side, curiously like the movement of a snake.

Perhaps the most remarkable characteristic of the cat family is the bristle-like hairs, known as whiskers, that fringe the muzzle.

These whiskers help cats in finding their way, and detecting objects during their nightly wanderings. It is said that if a cat's whiskers can pass through a space, its body can follow.

Consider the delicacy of these nerves of touch that are in a cat's whiskers. The whiskers themselves are most delicately fine, and so what must these nerves be like which communicate with the brain, and serve a cat so well?

The immensely great in nature causes the mind to stagger, and breaks down the power of our imagination, but the infinitely little exceeds the limit of our thoughts and imaginings none the less.

As a rule, the cat family kill their prey by the most clever scouting, combined with stalking. Upon seeing their prey, they use every device to get within springing distance. They will advance a few paces, then crouch, then advance a few paces again, then lie perfectly still, taking advantage of every bit of cover, or it may be, they will lie in ambush, awaiting the approach of their prey, till it gets within a certain distance, and then they will pounce upon it with a sudden rush and spring, at the same time driving home their terrible claws. If you watch your cat hunt a bird you will see all this.

Where First Domesticated.

The ancient Egyptians tamed and trained the wild yellow Caffre cat of their country. The Egyptian fowler is said to have trained this cat, so that when he went fowling he took a cat as his companion, and it was taught to retrieve the bird that dropped to his throw stick, and fell amongst the tall grasses of his native swamp.

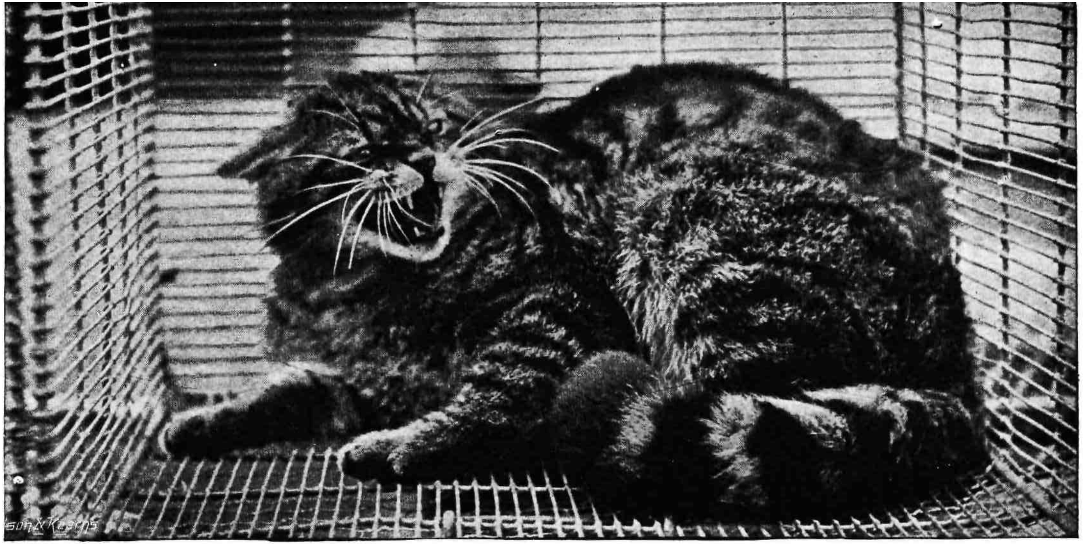
This cat is supposed to be the parent stock of our domesticated cat, but it has probably been

crossed with the wild cat of the different countries into which it was introduced.

The original wild British Cat is now very rare, and is mostly found on the inaccessible wooded mountains and hills, and in the northern parts of the country, principally the Highlands of Scotland. These cats are like our Tabbies in appearance, but they are larger and stronger. They possess a short head, and a short thick tail, of the same thickness throughout. As they live amidst trees, they are clever climbers. They are very savage, and sometimes when driven, they will even attack human beings. They live on hares, rabbits, lambs, and the game birds.

Owing to the hard life these wild cats are obliged to lead, in order to make a living, they carry no superfluous fat, but are a mass of sinew and cartilage, and in consequence are very difficult to kill, as for a matter of fact are all cats. Almost all the so-called wild cats in this country are probably domesticated cats that have become wild.

Owing to the cat's uncertain temper, its unsociable nature, and its propensity to attach itself to places, rather than to human beings, and its natural habit of sleeping during the day, and wandering forth at night in search of food, and its other noiseless, solitary, and



A WILD CAT (captured in the British Isles).

cat-like characteristics, it is not well adapted to become man's close companion.

And as its natural habits made it almost impossible for man to make the cat his companion and friend, he has interfered very little with its natural ways and disposition.

The cat therefore still remains partially a wild animal, and will on the slightest provocation, take to a wild life with little difficulty. In other words, it reverts back to type. That is, it reverts back very easily to the ways of its wild ancestors.

If a terrier is lost in a wood, it is almost as helpless as a babe, but if a cat is lost in a wood it is very soon at home, and soon loses every trace of domestication.

Domesticated Cat.

A good mousing cat will kill, it is said, ten mice a day, and put to flight out of a building a vast number more.

Different breeds of cats are not so marked as to size, shape, and habits as the different breeds of dogs. They generally only differ in colour, length of hair, and length of tail.

Owing to the dog's natural disposition, man could train it and use it for several different purposes, therefore he bred and selected with this object in view; but owing to the cat's

natural disposition he could not utilise it in the same way, and therefore he did not attempt to interfere much with its natural characteristics. This is probably the reason why the different

A WELL-MARKED ENGLISH TABBY CAT.

breeds of cats are not so marked as the different breeds of dogs.

The different colours of cats are, the tabby, black, white, sandy, tortoise-shell, etc.

The tabby cat is the most common English variety.

The tabby has a background of grey marked with black stripes down the back and on its sides and limbs.

Cats are said to possess much more limited powers of smell than the dog.

In securing its prey, it depends on its highly developed sight, its exquisite feeling in its whiskers, its softness and evenness of movement, its clever stalking, the accuracy and suddenness of its pounce, and the force and power with which it can drive its claws into the body of its victim.

As has been said, the cat is unsociable, preferring to hunt its prey in solitude, and generally at night.

Cat and Dog Compared.

The cat and dog have very different ways and habits. A cat is usually independent, a dog dependent. A cat is secretive, a dog is usually open. These different ways and habits, are probably the result of the different kind of wild life their respective wild ancestors were compelled to adopt.

The wild ancestors of the dog, probably wolves and jackals, lived in packs, and therefore had to obey a rough kind of social dog law. They gave each other mutual assistance in the searching, finding, running down, and killing of their prey; in guarding their community from

alarm and danger, by means of barks and growls; and by uniting to defend themselves, or to attack their enemy. They did not attach themselves to places, but wandered over large tracts of country, sleeping where they stopped for the night.

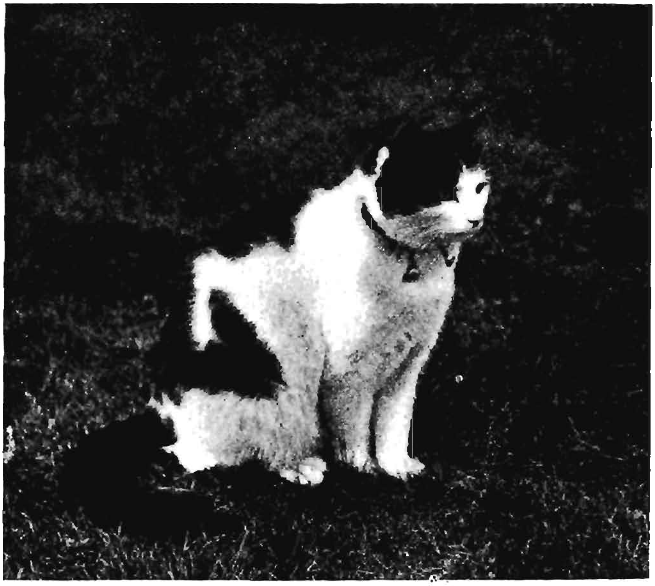
Such a life fixed in the dog certain sociable instincts, which when trained and developed, became of the greatest use and pleasure to man. Every movement of a dog shows that he is a sociable animal, and that his wild ancestors lived in packs: the movements of his tail, his attitude when meeting a friendly or strange dog, his greedy manner of eating, his great attachment to his master, and his manner of defending and guarding him, the wisdom he will show in finding and retrieving game; his manner of showing joy and fear and other emotions.

That he did not attach himself to places is shown when a dog lies down. He will twist round and round on your rug, as if he were smoothing down the long grass, to make himself a comfortable sleeping place for the night. Wolves and jackals when exhausted after their day's hunt, will smooth the grass down by turning round and round, so as to prepare a comfortable bed for themselves.

A dog's manner of digging a hole and burying a bone in it, is the old ancestral trait, when food

was scarce and precarious, of laying up the little store that was over, against the day when his hunting ended in a blank.

The manner a dog will follow his master, was

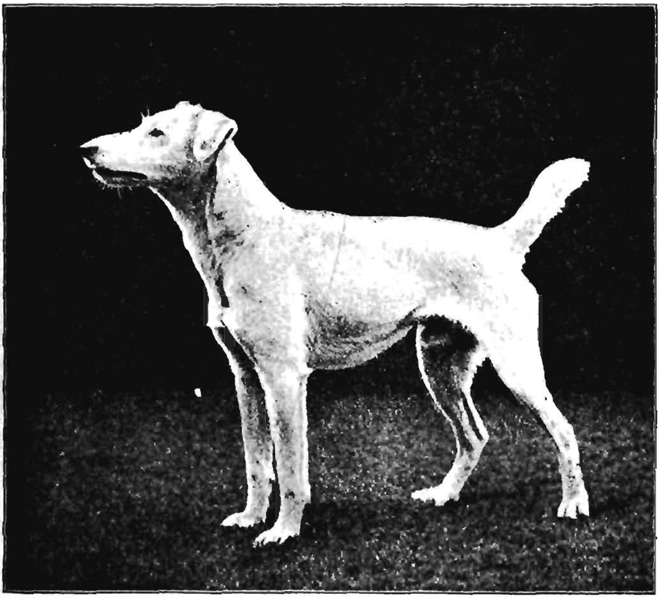


A HANDSOME CAT.

first learnt when the members of a pack followed and obeyed the leader of the pack. The wagging and quivering tails of a pack of foxhounds, as they spread through a covert, and search for or find the scent, are so many signals to one another, and were no doubt first of

all acquired when their wild ancestors lived and hunted in communities.

Dogs living in packs, acted with no concealment of their doings, hence the desperate



An old favourite and winner of many prizes. *Acton Speculation 95'* (K.C.S.B. 1013a).

haste to gobble down the bit of prey they were fortunate enough to seize, lest another and stronger dog of the pack should snatch it away.

Now consider a cat's habits :

A cat seldom or never cares to be in the company of other cats, she prefers to hunt alone,

and at night; she attaches herself to a house instead of to her master, showing that her wild ancestors attached themselves to a particular spot or lair, a cave, a hole in a rock, the hollow of some tree, or some other place of safety. Their delicacy and slowness in eating, prove that they took their time to eat their food; the male, female, and young together, not with a number of other hungry half-famished cats all around, ready to seize on the piece that a fortunate cat had been lucky enough to secure; and their great natural cleanliness of person and habits were also acquired so that their lair might be kept sweet and clean.

A cat never hides away a bone like a dog.

Almost every habit that we observe in our dog and cat, can be traced to the different methods that the family of dogs and of cats were respectively compelled to adopt when in a wild state in order to make a living, and to rear their offspring.

A Cat's Snake-like Habits.

It is interesting to note as your tame tabby lies curled asleep in front of the fire, how curiously it resembles, in its markings and shape, certain snakes, and when awake, how some of its traits resemble those of the snake.

When it is angry, with its ears pressed flat

against its head, notice its snake-like look, its glassy glaring eyes, its exposed fangs and gnashing teeth. Then, further, notice the tail twitching from side to side—a snake-like movement as it approaches its prey—and then how it jerks its tail before it springs, similar to snakes preparing to strike.

Notice the sharp and prolonged hiss, and then the quick spit.

Are these snake-like characteristics of the cat mere coincidences? or have we to seek some other explanation?

Have these snake-like characteristics been acquired by the wild cats, and if so have they helped them to preserve their life from their enemies?

A certain observant naturalist gives the following reasons for these curious resemblances in the cat and the snake. They are so interesting and suggestive that we are tempted to give an outline of them.

Eagles are very fond of cat flesh. Keepers of caged eagles will give them cat's flesh, which they will eat readily, when refusing all other food.

A wild eagle will pounce upon a wild cat and drive its talons through its ribs and flanks into its vital regions, while bewildering the animal with the constant flapping of its strong wings.

Wild eagles are found in regions that wild cats

mostly inhabit, namely, mountainous districts studded with trees.

Eagles dislike and fear snakes, and a cat lying asleep on a bough of a tree is strangely like a snake curled up. The eagle might mistake the sleeping cat for a snake, and so might leave it. Such is the theory, and it is given for what it is worth.

There is another point that you must notice about the cat; it has a very strong dislike to getting wet, and yet it has a great liking for fish, which we have probably all experienced, when we have left our fish for dinner unguarded from the cat. How is this to be accounted for?

Notice the play and natural habits of young things, for they will often give you many valuable suggestions as to their line of descent, and as to the manner of life their ancestors lived in the distant past.

Observe the natural habits of your animals, learn something of the surroundings in which their wild ancestors lived, then feed them, house them, and discipline them as nearly as is practical along those lines, while training them kindly but firmly, and slowly, in the direction you wish them to take, and then you will get the best out of them, and they will become healthy and happy, and render you their best service.

OUR COMMON REPTILES.

MEN, animals, and most birds dread and dislike the reptile form of life, especially that form of reptilian life known as the snake.

When we wish to mark with disapproval a speech or a word or an action, our strongest contempt is expressed by pointing the finger of scorn, accompanied with a snake-like hiss.

To say that a man is snake-like in his habits, is to utter our strongest condemnation.

When a man's character is underhand and mean, we say that he is like a snake in the grass.

In many of the great religions, the lower and physical nature, that is contending against the higher and more spiritual nature, is represented in the form of a serpent.

Are there any reasons to account for these facts? Let us see.

The habits of reptiles may have had something to do with it. Their method of crawling and wriggling about, and their manner of concealment, and the sudden and awful swiftness of

their strike; and, in the case of the harmful snakes, the tiny drop of deadly poison concealed in the small poison bag, which if the fang pierces the skin mingles with the blood and causes so much suffering, and in many cases such a horrible death. These characteristics awaken our antipathy.

In the hotter climates, where man at one period of his history attained his highest development, these harmful snakes lived in great numbers, and must have brought suffering and death to a large number of human beings.

The constant warfare, and the perpetual dread that the concealed life of the snakes must in the course of time have fixed in the mind of man, probably accounts for this natural repulsion to the snake. This repulsion, having been transmitted from generation to generation at last became fixed, and is inherited by us to-day.

Animals, when snakes were more numerous than they are now, must also have had their conflicts and suffered losses. And this legacy of the past is suggested by the terror most animals will show on seeing a snake, although they may never have seen one before.

The following facts may also partially account for this universal shrinking from the reptilian form of life.

At a very remote period of the world's his-

tory the most dominant form of life was the reptilian. Huge reptiles they were, as their fossil remains amply prove. Flying reptiles, swimming reptiles, and walking reptiles, filled all the available spaces of the earth. The earth's unsettled surface was not then a fit abode for the higher forms of life, and so the higher forms did not appear. At last the conditions of atmosphere, relative position, and stability of land and water, and a more developed vegetation, made the earth suitable for the support of the higher forms of life, and so gradually the higher forms evolved. But an awful fight now began, and it must have extended over a long period of time. Which was to be the master, the higher animal, and at last human life, or the lower and huger reptilian life?

Slowly but surely, the higher life gained the victory, and compelled the reptilian form to take up a subordinate position. But the victory was not gained without leaving its inheritance, an inheritance that we still feel to-day, the inheritance of repulsion, that most animals and birds, and most men and women, feel for all reptilian forms of life.

Of course it is only theory, a plausible theory if you please, but still a theory. As you have already read, try to find out a reason or probable theory for everything. Because it helps the

mind to enquire, to observe, and to reason, and at last it helps the mind to build up a logical, reasonable, and workable theory, to account for things as we see and know them.

The Reptiles

found in this country are very few, and except in one instance, that of the Viper, they are quite harmless.

The word reptilia, or reptiles, at one time included the Tortoises, the Snakes, the Lizards, the Toads, the Frogs, and the Newts.

But now it is only the Tortoises, Snakes, and Lizards that are included in the class termed reptilia; while the Frogs, the Toads, and the Newts are included in another class called the amphibia. We will treat these different classes separately.

The reptiles are very rightly called cold-blooded animals, because when compared with the animals and birds above them in the scale of life, their heart and power of breathing are not so highly developed, and therefore their blood is less in quantity, and lower in temperature.

The reptile class can be divided into three orders: first, Tortoises and Turtles; second, Lizards; third, Snakes.

The Tortoises and Turtles are not found at large in this country, therefore we have not the space to say anything about them.

The lizard family are represented by the Common or Scaly Lizard, the Sand Lizard, and the Slow or Blind Worm.

The Common Lizard, called the scaly lizard. The young at the time of birth burst through the thin membrane of the eggs, and are therefore called ovo-viviparous. As soon as the young lizards are born they are lively, pretty little creatures, and run about with their parents in search of their insect food.

These lizards are generally to be found on dry banks and heaths in elevated districts, sunning themselves in the sun between Spring and Autumn. Their movements are graceful and quick. They dart with great suddenness upon any insects coming within their range, and these at once disappear down their throats.

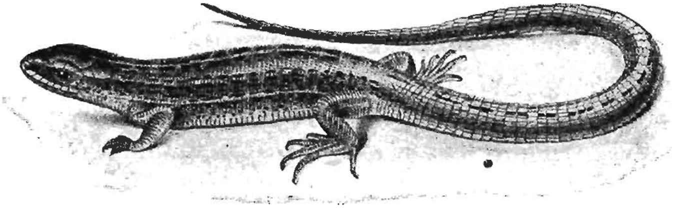
They are perfectly harmless, and ought to be preserved, because not only do they add additional interest to the wild life of the country, but also consume a great quantity of insects. If you have any kind of fernery, place a lizard there; it is interesting to watch its habits, and you will find it useful in keeping down the insects.

The Sand Lizard is larger than the common lizard, and does not bring forth matured young at the time of birth, like the common lizard. The female lays 12 or more eggs in a hollow or cavity, or in a nest which she hollows out,

and covers the eggs with sand, leaving them for the sun to hatch.

This lizard is not so easily domesticated as the common lizard, and is of a snappish nature, and if confined refuses food. It passes the winter in a state of repose or hibernation, a reptilian habit which is explained later.

There are two varieties of the sand lizard—the one possessing a brown tint, and the other a green tint. Snakes are fond of lizards as a food.



SAND LIZARD. (½ Nat. Size.)

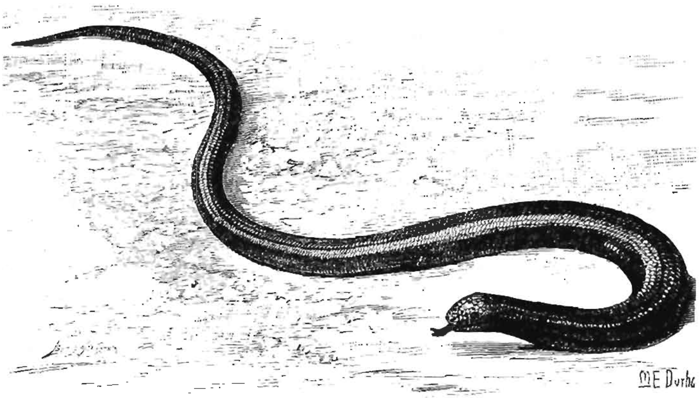
Again we repeat, do not kill the lizards, for they are quite harmless, and do a great deal of good by destroying a number of insects.

Giants of this order are found living wild to-day, and are in some cases 18 feet long, for example the Crocodiles of the Nile, and the Alligators of North America. None of these kill their victims by poison, but seize and kill them with their huge mouths and strong teeth.

Slow or Blind Worm. This reptile is so like a snake that it is often mistaken for one, but a careful dissection of its body proves that it is in

reality a lizard. It has not external legs, but has rudimentary legs concealed beneath its skin. Its eyes are furnished with movable eyelids, a trait that is not found in the snakes, but is found amongst lizards.

The jaws of a snake are so constructed that they will admit as large a body as will pass



SLOW-WORM. (½ Nat. Size.)

into its stomach. The mouth of the blind-worm, on the other hand, is much smaller, and is only adapted to swallow insects and such small fry. A snake's tongue is cleft or forked at the point, but a blind-worm's tongue is notched at the point. A blind-worm's stomach, sides, and tail are covered with small rounded scales. For these reasons a blind-worm is really a lizard without visible legs.

Like the snake, it casts its skin—"sloughing," as it is termed. The skin is turned inside out, and is left where it is cast off. It has seven, eight, ten, or twelve young at a birth, which are at once capable of taking care of themselves.

The peculiarity about the blind-worm is this, that when attacked, alarmed, or taken hold of, it becomes rigid, and when in this condition any effort to bend it, results in breaking off a portion of the tail. A slight blow also will sever the tail, and when the tail is seized it comes off in the hand.

It seems to be able partially to restore the broken tail, for a short conical tip grows in the place of the severed tail. It is timid, inoffensive, quiet, and very shy in its habits. When touched it will turn and bite, but not with sufficient sharpness to draw blood.

It measures about fifteen inches, and is fond of white slugs, eating six or seven of them one after the other. It does not like water.

Snakes and vipers will endeavour to escape from you with great rapidity of movement, but the blind-worm will make little or no effort to escape. It seems to become paralysed with fright.

Some think it cannot see well, hence the name blind-worm; but its eyes, though small, are perfect.

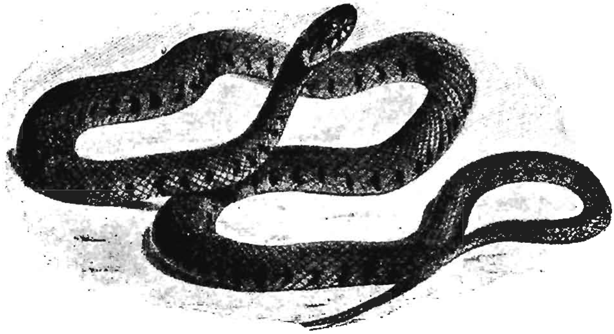
It lives amongst the rough foliage of banks,

but like all the reptiles it loves warmth, and so it creeps, half torpid, from its hiding-place, to bask in the sun, and then if it should be seen it is too often foolishly killed.

Its form and scales are exquisitely polished, and are exactly suited for rapid and nearly noiseless movement through the grass. In the sunlight it looks like a thick piece of lustrous, untarnished copper wire.

Snakes.

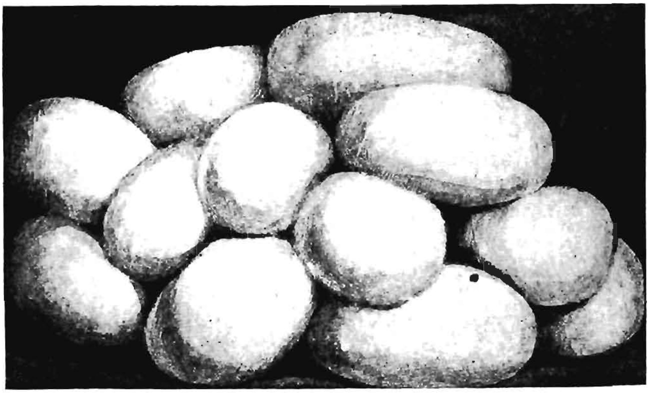
The common or ringed snake is the common variety of snake found in this country. It is



THE COMMON SNAKE. (½ Nat. Size.)

quick and graceful in its movements, and possesses a very fascinating eye. It is easily tamed. Its eggs are 14 to 20 in number, and are attached to each other by a glutinous secretion. To obtain the necessary heat for hatch-

ing them, they are often deposited in dung heaps. Sometimes they are exposed to the direct heat of the sun. These eggs are a little larger than the sparrow's egg, obtuse in shape, and of a very pale yellow colour. To the touch they feel tough, and yet soft, like little bags of some gelatinous sub-



EGGS OF COMMON SNAKE. (Enlarged.)

stance. The parent snake, having deposited her eggs, takes no further trouble with them.

Snakes change their skins several times a year—"sloughing," it is termed. They first of all burst the exterior skin round their necks, and then slowly, bit by bit, draw out their whole bodies. During the process the skin is turned inside out.

The snake eats insects, frogs, young birds, eggs, and sometimes mice.

If a frog is caught by the hind leg by a snake it seems paralysed with fear, for it will stretch out its whole body, and will not attempt to escapé. The snake then proceeds to draw in, first the leg it has seized, then portion by portion the rest of the animal. It does this by means of a peculiar mechanism of the jaws, which are admirably adapted for this purpose.

While the unfortunate frog is being swallowed it is alive, and is probably alive for some time after it has reached the stomach, for snakes have been opened, and frogs have jumped out seemingly none the worse for their burial alive.

Snakes are generally found in damp places, and not far from water, and in the summer they can often be seen lying in water with their heads just above the surface. The ringed snake is usually from two feet to three feet long.

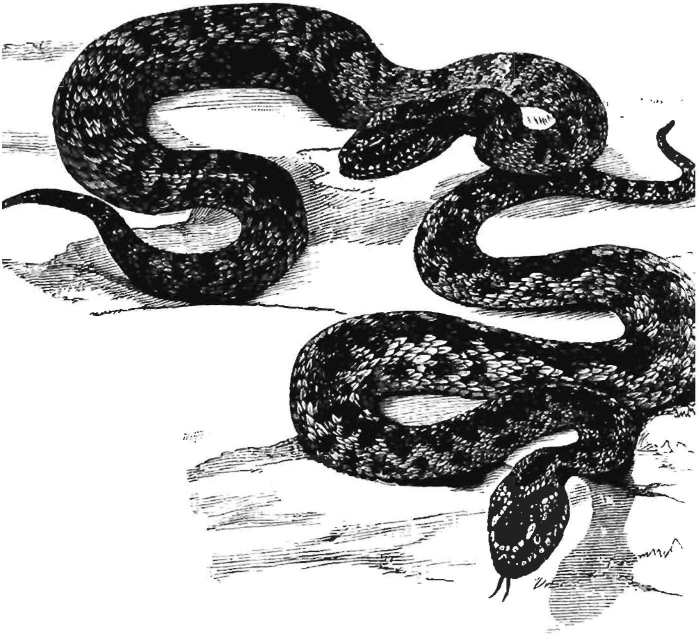
The Viper or Adder is the only poisonous snake found in this country. Unlike the common snake it is not fond of water or damp places, and so is generally found in dry woods, heaths, or sand-banks.

The viper is ovo-viviparous, that is, the young escape from the eggs at the time of their birth. They generally number between ten and twenty.

The young vipers, immediately they are born, are vigorous and pugnacious, twisting and wriggling about, and if touched they open their

tiny mouths very wide and show every sign of defiance.

During the winter vipers retire to some snug spot to hibernate. A company of vipers may

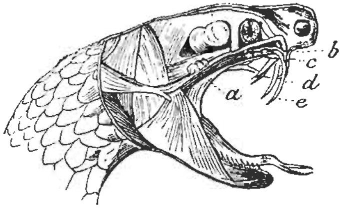


THE VIPER OR ADDER. (½ Nat. Size.)

sometimes be found, wrapt in each other's coil, in a hole at the foot of a tree. They remain without food till the spring, when the sun's warmth calls them into activity again. Once or twice during the summer the skin becomes loose,

and turning it back the reptile draws itself out of it, leaving it behind on the ground. When this is accomplished the reptile is much brighter than it was before "Sloughing."

The Poison and Strike. Owing to the greater activity of the Viper during its summer life, it is said to store a larger quantity of more acrid poison, than it does during its inactive



HEAD OF A VIPER, SHOWING THE POISON SYSTEM.

a, Poison gland; *b*, poison duct; *c*, poison reservoir; *d*, fang like a hollow tube, through which the poison passes from the reservoir into the object bitten; *e*, opening through which the poison passes.

winter life. The poison resembles in appearance the saliva of animals and man.

It is stored in a gland situated at the side of the head—(see diagram),—and from thence it flows by means of a canal or duct, to the tooth or fang.

The fang is a tooth in the form of a tube, which is curved, and much longer than the other teeth. There are two of these fangs, one on each side of the upper jaw. On the outer surface, in the upper part of the fang, is an elongated slit.

This slit is united with the duct, which is in its turn united with the poison glands.

When striking, the Viper opens its mouth wide, erects its fangs, which naturally lie backwards along the sides of the palate, and plunges them into its enemy by a blow of the head or upper jaw.

The instant the teeth are buried in the body struck, the poison stored in the poison bag is driven down the canal into the slit of the fang, with a force proportional to the vigour and range of the reptile and the supply of poison stored up in the poison bag, and from the fang it passes into the wound.

When the fangs are not in use they fall backward, and lie concealed by the gum.

A Viper before striking its prey, coils itself up with its head in the centre, or at the summit of the coil. Then it draws back its head a little and uncoils itself, like a spring, with such rapidity that the eye for the moment cannot follow it. In the act of striking the Viper covers a space nearly equal to its own length. It does not however launch forth the whole of its body, but remains supported on the ground by its tail. If the first blow should fail it quickly coils itself up again, and strikes a second blow as rapidly as the first. The bite consists of two very small punctures made by the entrance of the poison fangs into the skin.

The bite of the English viper causes sickness, faintness, feverishness, and great weakness, but it seldom causes death.

On the approach of danger or of alarm, the viper opens its mouth wide, so that its young may pass down its throat, and find safety in its stomach ?

Many naturalists and eminent observers state that they have seen this act performed, while others decide that it still remains an open question. Try to settle it for yourselves.

Viper and Snake—The Difference. The only safe way to distinguish the viper from the common snake is by a practical familiarity with the two reptiles. The snake is commonly larger than the viper, and is found in damp places near water, while the viper is generally found in drier situations. The snake has a few large plates or scales upon its head, while the scales of the viper are numerous and small.

The snake has no continuous line of dark colour running along its body, but is spotted all over. The viper has a long continuous line, zig-zag and blotched, running down its entire length. The head of a snake is more depressed and more acutely pointed in front than that of the viper. The viper also has a blotch, something like a Death's Head Moth, on the top of its head.

The colour of the viper varies; it is often

brownish or olive, but this may become nearly black, or it may be pallid grey, nearly white, or of a warm red brown.

The chief markings of the viper are, however, the dark mark between the eyes, a spot on each side on the back part of the head, an obscure V, as though it bore the initial of its name on its crown, and a broad zig-zag line of brown blotches down the whole length of the upper side of its body and tail.

Hibernation.

All reptiles hibernate during the winter. They retire to holes, crevices in rocks, or other snug places, either in company or singly, for a six months' sleep, more or less.

During this sleep they remain without food till the sun in spring time hastens the circulation of the blood, and calls them into activity again.

This problem of hibernation is a very interesting one and so the author offers a few suggestions concerning it.

What is the cause that compels certain animals to hibernate? We are forced to believe that it is a question of food supply. If you think, it will strike you at once, that only those animals hibernate whose food, whether insect or vegetable, cannot live or is not obtainable, during the cold of winter.

If then, these animals were to survive, some device had to be adopted to enable them to live through the cold of winter, when little or none of their natural food is to be obtained. And to live through the winter in a state of activity, would necessitate their taking even more food to keep them warm and alive, than they would require during the warmth of summer.

During the hibernation sleep, their life-principle is at the lowest point ; the heart and circulation of the blood are only just kept going; in other words, their vitality is at its lowest ebb, they are in fact just at the point of death. Therefore, they require little or no food to keep their low vitality, or their life, from flickering out.

Most animals that hibernate lay in a reserve store of fat during their times of plenty, which they slowly consume, and which is just sufficient for them while they rest torpid in their winter sleep.

Certain birds, instead of hibernating, migrate to places where the sun is warm enough to allow their food to live.

Certain deer, rats, voles, and other animals, will travel long distances to places where they can obtain suitable food, and return again when the climate allows their food to re-appear in their natural haunts.

Frogs, Toads, and Newts

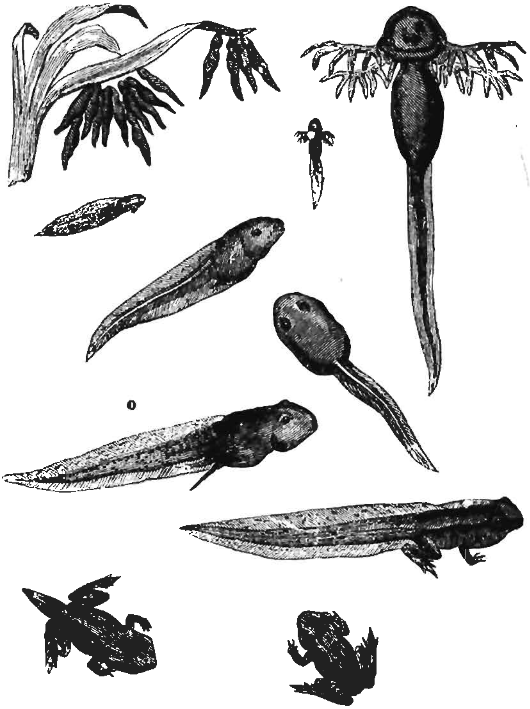
are called amphibia, because at one period of their life they live in water, and have organs adapted for water life; and at another period of their life they live partly on land, and in consequence change their aquatic organs for those organs suited for a life on land.

The fact that in later life they become land animals suggests that at one period of their ancestral tree, remote from the present, their ancestors lived wholly in water, and that it was during their later history that they adopted the twofold method of living with which we are familiar to-day.

Frogs. We will now very briefly state the steps by which this wonderful transformation is accomplished, taking the frog as our illustration.

Frogs spawn about the middle of March. This spawn consists of a large number of small round opaque bodies enclosed in a glairy mass. The Spawn or Eggs are deposited by the female frog at the bottom of pools and ditches. By the absorption of water the envelope of the eggs swells, and then each egg looks like a black dot enclosed within a coating of gelatine. The masses of eggs soon rise to the surface of the water, and are then called Frog Spawn. In a

very short time in each egg may be seen a head and tail, and round the tail a fin. Then the water-breathing apparatus or gills appear. At



STAGES IN THE DEVELOPMENT OF A FROG. (Mivart.)

last the little tadpole emerges into the world. Soon the gills attain their full size, and then they are gradually withdrawn into a fold of the skin.

The Tadpole continues to grow, day by day increasing in bulk, without material change. At last small, or rudimentary, legs appear, but as they begin to grow the tail is slowly absorbed and lungs develop, until the little tadpole ceases to be a tadpole and becomes a frog.

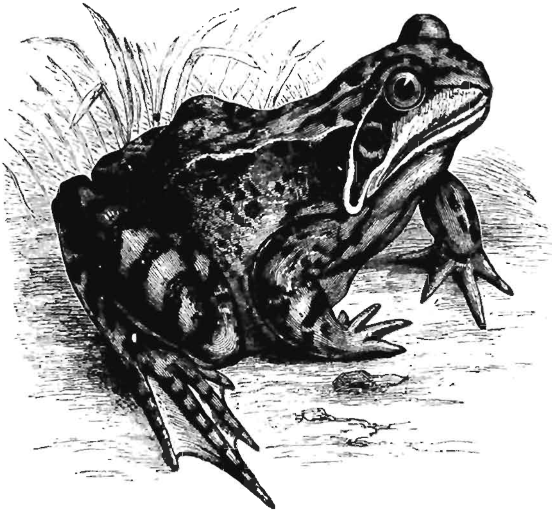
During its tadpole life it seems to feed almost entirely on vegetable life, but when it becomes a frog it lives on minute insects, such as little green plant lice, small slugs, and other forms of insect life. When winter comes the full-grown frog retires to winter quarters, hiding in holes in the ground in considerable numbers; very often they bury themselves in the mud.

When the spring comes round they break up their winter community, and seek ditches, shallow pools, swamps and swampy bogs, in which to deposit their eggs, which they leave to develop.

It is hardly necessary to describe the common frog because it must be so familiar to you, but there are certain peculiar characteristics about it which it would be well for you to note.

The head is nearly triangular. The teeth minute, and arranged in single rows across the upper jaw, with none in the lower jaw; the tongue folds back upon itself when not in use. This tongue, that can be unfolded to reach at a distance from the mouth, is serviceable for picking up insects. As the frog's food consists of

small insects, larger teeth would be superfluous. The third toe is the longest, and the second the shortest on the front feet. The hind legs are more than half as long again as the body, and enable the creature to take the leaps with



THE COMMON FROG. (Mivart.)

which you are so familiar. The toes are webbed, and the fourth toe is one-third longer than the third and fifth. The legs assume the form of bags. The skin is wrinkled on the thighs, but elsewhere it is smooth. The upper parts are brownish or yellowish brown, sometimes dark and spotted with black.

The Edible Frog. It is doubtful whether

this Frog is a native of this country, but it has been imported with considerable success.

On the continent the legs and other parts are eaten, and are considered a great delicacy, being in flavour like the most tender stewed rabbit or young spring chicken. Whole ponds are given up to the rearing of the Frog, and yield a considerable sum of money.

Why should not this be attempted in England? There are plenty of ponds in this country, which are doing absolutely nothing, which only require cleaning out, and stocking with the edible frog to become interesting, and also the means of earning money.

All the Frog family utter sounds which are called croaking, but the croak of the edible frog is much louder, and more musical, than that of other species of the frog.

On a hot summer's night, the croaking of a number of frogs in concert is by no means unmusical, and is very remarkable. It seems as though there is always a leader, who begins the concert with a voice which some people think is like an agreeable tenor. After a few seconds of this solo singing, the other Frogs of the community join in the concert, and the chorus begins. It then dies down, and is followed by a few moments of silence, the leader then begins again and the programme is repeated.

The Edible Frog can be distinguished from the common frog, by the absence of a conspicuous dark patch from the eye to the shoulder; by the presence of the vocal sacs or bladders at the angles of the mouth, by its more distinct and beautiful markings, by its louder note, and by its larger size. There is not much difference

EDIBLE FROG, *Rana Esculanta.* (Mivart.)

in its food and habits, except that the Edible Frog lives more in water, in rivers, rivulets, streams, lakes, ponds, salt or fresh marshes, ditches, swamps, and pools of water. In the pools abroad, that are given up to rearing the edible frog, they can be seen on the water lilies, or on the herbage of the banks, basking in the sun, but if they see you they will at once disappear, and will not re-appear till the danger has passed.

Their colour is very variable, from a greenish tint to rich chestnut red. Their length about three inches.

Common Toad. The Common Toad is a more repulsive-looking creature than the Frog, and lives a more terrestrial life, and is of a more sluggish disposition.

There is little difference in the early stages of the two species. The eggs are deposited in spring. The Tadpoles pass through the same stages, but the Tadpoles of the Common Toad are darker in colour.

In the autumn, the Tadpoles, having attained their legs, and lost their tails, commence a life on land as miniature Toads, crawling about in search of food.

The eggs however, are not deposited in a mass as are those of the frog, but are arranged in double chains.

The most remarkable characteristic of the common Toad, is a thick milky poisonous substance with a slight yellow tint, and a disagreeable caustic taste, which it is said exudes from pustules or pimples on its skin, and is used as a weapon of defence when the Toad is attacked or becomes excited. That this substance is of a poisonous nature, when it finds admission into the blood, there can be no question.

Birds have been inoculated with it, and have

died in about six minutes. A small quantity of the fluid was introduced beneath the skin of a dog and of a goat and it caused death in an hour.

If the poison by any means finds its way on to the back of Frogs it is said to kill them, but it is said to have no effect on the Toads themselves.

Toads feed on Wood Lice, Worms, and Black Ants; they are easily domesticated, and become attached to their masters.

THE COMMON TOAD. (Mivart.)

Place a Worm before a Toad, and then watch its curious movements. The anticipation of a meal will cause it to change from a lethargic to an energetic individual. The eyes will become full of animation, and its hind legs will tremble, and directly the worm moves, it will seize it by the middle, and with its fore feet will force it down its throat in the most greedy and disgusting manner.

Try and observe all these things for your-

selves. Observation, like everything else, must be cultivated, and when once cultivated the whole country side will teem with interest for you. The movement of every animal, the flight of every bird, the rustle of every insect, the life in every hedge and in every tree, will fill you with profound wonder, and set you thinking, "why." And in the search for "whys" lies the interest and mystery of life.

The Natterjack is not so common, but is very similar to the Toad, though it is different in colour. It is less sluggish and more interesting than the toad, it indulges in a rapid walk, and can climb almost anything. The Natterjacks are generally seen in pairs. They seem also to be a bit wiser than toads, for on the approach of danger they will leave off croaking, and will crouch near the ground, in order to try and escape observation, while the Toad on approach of danger will foolishly keep on crawling and croaking.

They are fond of remaining in shallow water, with their heads just above the surface, and they are especially fond of living amongst reeds.

Wandering as they do by night, their eyes are keener by night than by day.

When excited they give off a peculiar odour, some people say, like sulphur.

One of our naturalists reckons the eggs deposited by one female at not less than 19,000.

The Frog and the Toad produce quite as many. What then becomes of these myriads of Tadpoles,—Frogs, Toads, Natterjacks? In the water, the Eggs and Tadpoles are eaten by all manner of fish, Dragon Flies, Water Beetles, Boat Flies, or the larvæ of these insects, and the Newts; and when they take to a life on land, they are eaten by Snakes, Weazels, Pole Cats, and every species of Water-Fowl. It is reckoned that only one young Frog out of every thousand survives to reproduce young. But how this calculation is reached the writer is unable to say.

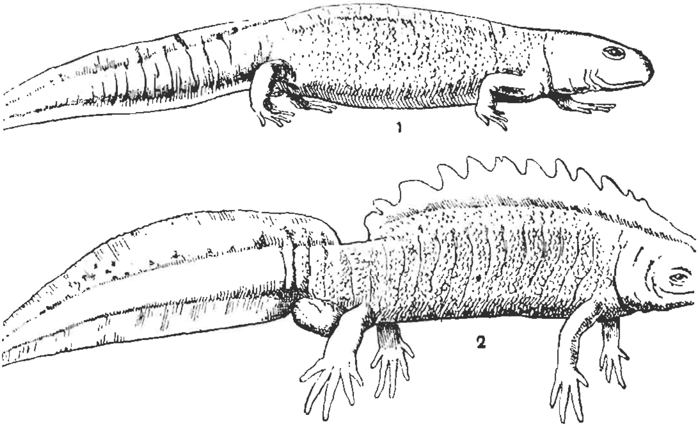
Newts or Tritons.

For a long time the Newts baffled our naturalists. Sometimes they lived in water, sometimes they did not; sometimes the male was seen with a crest running down his back; at other times no crest was to be seen; sometimes they were of a bright colour, at other times of a dull colour. Small wonder that they were taken by naturalists for different species, instead of, as is the case, being one and the same individual, adopting these several phases for the due carrying out of its life.

The question was finally decided, by the careful observations of a true naturalist, who kept them in confinement, and under close observation for five years.

Would that we had many more such observers amongst us. What we require, above all things, is the naturalist who will observe patiently, and record accurately the habits of the living creatures all around us.

With a little patience and knowledge, and some accuracy of thought and memory, and



TRITON. 1, Female; 2, Male.

with kindness of heart towards the living thing itself, we can each add our mite to this knowledge, which is now so sadly deficient. You can all do something to build up this knowledge.

You can take your place under a hedge, and with a liberal mind and kind heart observe carefully the ways and doings of the wild life that comes within your range of vision, and the

exercise will enlarge your soul, and build up your character. It will help you to depend more on your own powers of observation, than on the observation of others and the information contained in books.

In such observation and feeling lie true education, and the highest knowledge.

We will now give an outline of the result of a naturalist's five years' observation of the newts or tritons.

Egg of the Triton just after deposition, with the outer membrane opened. (After Jordan.)

Great Water Newt.—The eggs or ovæ are deposited in April, and continue to be deposited till the first or second week in July. Each egg is enclosed in a fold of the leaves of certain aquatic plants, commonly those of the water Speedwell, and the leaves of long grasses.

If a plant with long leaves is blown into a pond during the breeding season of the Newts or Tritons, it is often found with its leaves folded, and within each fold there is likely to be a little globular-shaped egg, protected by a delicate but firm shell or capsule.

This egg is covered with a sticky substance

which enables it to hold fast to the leaf in which it is folded.

In three weeks' time the little Triton-tadpole, or Newt-tadpole is hatched, and escaping from its leafy confinement swims away freely.

For three months it lives in the water as a tadpole, and at the end of that time it gives signs that it proposes to live on land, by the appearance of little budding legs. When the legs are fully grown, and its lungs have developed, its gills gradually disappear, and the Triton leaves the water to enter upon its terrestrial existence.

If the Triton-tadpoles are hatched late, they may not appear as Tritons till the following spring. It is reckoned that the whole metamorphosis takes five or six months to accomplish, from the depositing of the egg on the leaf, to the emergence on dry land of the Newt or Triton.

Now comes the interesting period in the life history of these creatures that so long baffled the naturalist. The Triton does not return to the water till it is three years old, when it is sufficiently matured to produce its young. At this time the Triton selects a mate, and they return together to an aquatic life.

The female deposits her eggs, and after three months of this second life in the water, they both return to a terrestrial existence, the same course

being followed year by year. Thus are the phases of their life passed. When these different phases were unknown, the creature during each was regarded as a separate and distinct species or form of life.

When the full efthood is reached, at the end of three years, the male puts on a crest, and the crest remains undiminished during the breeding season, but disappears on the return to terrestrial life. The female has no crest.

1st	year	length	triton . .	2 inches
2nd	,,	,,	,, . .	3 ,,
3rd	,,	,,	,, . .	4 ,,
4th	,,	,,	,, . .	5 ,,

In the first and second year the skin is only slightly rough. In the third year it is rough, and in the fourth year it attains its warty development.

In the first and second year there is scarcely any difference in the appearance of the sexes, but during the breeding season, in the third year, the male puts on a young crest, the tail expands, and the permanent silver stripe appears along each side. About September, for the purpose of hibernation, they collect in great numbers, and bury themselves in moderately damp places, in holes, etc. It is however said that Tritons in their third and subsequent years hibernate

in communities, while during their earlier life they hibernate singly.

During this hibernation sleep, no food is taken or required, the body is stiff, the respiration slow, and is said to be given off through the pores of the skin.

The Smooth Water Newt is the most common species found in this country, and can be seen in almost any clear ditch or pond, where it feeds on aquatic insects and worms. It is perfectly harmless, but owing to a most absurd superstition, it is often tortured and killed. Its life history is much the same as the water newt, except that instead of laying its eggs in the folds of leaves, it is said to deposit them in Spring, from four to six in number, about the roots of aquatic plants. In September, in communities, they seek out a comfortable spot to hibernate, under stones, bricks, or pieces of timber. In the early Spring, the mature animal emerges from its winter sleep to take to itself a mate, and to seek the water for the purpose of breeding.

At certain times of the year all Newts cast their skins.

Let Live, Let Live.

In reading about these reptiles, it must have struck you that they all,—the viper perhaps excepted,—are harmless, and that they do good

by consuming a great quantity of insects both in the water and on land, and therefore how utterly foolish it is to kill them.

In the present day, when there is growing up such a strong tendency on the part of all classes to live in crowded centres, because of the life, amusement, and interest that is found there, it is imperative upon all of us who love the country, and would like to see more interest taken in country affairs, and the villages made the scenes of more life and amusement, that we should make the country as attractive as possible. And one source of attraction, and a growing one, is the wild life still lingering in the country. To go into the country, and to see the wild creature living its own unhampered natural life, is a source of great pleasure and profit to an increasing number of people.

To stamp out a species of wild life is to inflict a most grievous national loss. No tears, repentance, brains or money, can repair that loss, can restore that living form. Once gone, it is gone for ever, and all future generations are deprived of the pure pleasure of searching for, and observing the wild creature living its life, as it was intended that it should live.

To kill when there is no necessity to kill, is it not a form of murder? Life is a solemn mystery. It comes forth from, and is connected

with, the great source of life which appears in every form, no matter how lowly the form, so that it may fill its necessary part in the Great Order. It is not useless, or be sure it would not be there.

And again, from the utilitarian point of view, it is a serious matter to kill the insect and vermin eating forms of life.

Many insect plagues, and diseases of crops, fruit, and flowers are due to the slow disappearance of those forms of life, which keep in check an undue increase of vermin and insect life.

Some districts have suffered more than others, and in this country, up to the present, such ravages have only been partial and local. But if the destruction of these useful creatures goes on unchecked, we may wake up one fine morning to find upon us a national devastation, which will cost the nation large sums of money, and cause the ruin of many of those whose interests are bound up in the prosperity or adversity of British country life.

Therefore, the writer earnestly appeals to all teachers and preachers, landlords, agents, tenant-farmers, game-keepers, cottagers, and country children, to do all they can to preserve the insect and vermin eating forms of life from extinction.

FISH OF OUR PONDS AND STREAMS.

In looking around you, and from what you have read in the *Readers*, you must have been struck at the wonderful manner all forms of life are adapted for the life they have to lead, the bird to fly, the reptile to glide, the animal to take to its heels, or to stand at bay and fight for dear life; and the animal, bird, and reptile also, that is obliged to track, pounce upon, and pull down others, if it is to live and not die.

In outward shape, and in the cover and colouring of that shape; in speed, strength, agility and spring; in eye, lung, and stomach; in instinct, intelligence, and wisdom; how wonderfully all is adapted to enable the creature to live the life it has to live, and to do the work it has to do, in the perfect plan of the Universe.

And yet two vertebrate creatures, so different in appearance and habits as the bird and the fish, are said to be but deviations from a common, more simply constructed, and less intelligent ancestor.

Students of science, men who have devoted, and who are devoting, all their time and thought, and in many cases, sacrificing ease, comfort and even life itself, in their search after the hidden truths of nature, tell us that all Vertebrate life ages ago was of a much simpler structure than it is to-day. That as time went on and conditions changed, deviations took place from this simple pattern or Ancestor, in order that all spaces of the air, water, and earth might be filled with those forms of life best suited to live there.

The fish is said to be nearer this primitive pattern or Ancestor than the bird, in other words it is not so highly developed as the bird.

How beautifully and wonderfully formed is a fish for living its life in the water. Consider these few points. The head of a fish is pointed, and gradually slopes upward towards the brain. The body is thin and deep in girth, and gradually slopes away to the propelling tail. The whole shape is like a piercing wedge, a shape admirably adapted for gliding quickly through the water, with the least resistance, splash or disturbance.

Along the back and sides there are projections called fins. The fins on the sides are paired, and are four in number, the pair nearest the head being called Pectoral fins, the pair nearer the tail being called the Ventral fins. Of the

unpaired fins the one on the back (some species of fish have two, for example the trout) is called the Dorsal fin, and the one underneath near the tail is called the Anal fin.

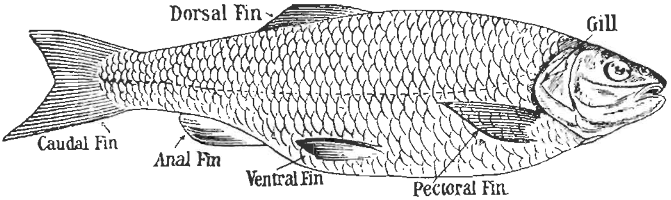
The paired fins on the sides balance and steer the fish, and correspond with the arms and legs of terrestrial animals. The foremost, or Pectoral fins, check the movement of the fish forward and help it to move backward. The paired fins act also as steerers, and that they act as balancers can be proved by the following facts.

If a fin on one side of the fish is lost, it falls over on its side. If the Pectoral, or forward fins are lost, the head of the fish sinks. If the Ventral, or hinder fins are lost, the steering of the fish becomes wild and uncertain. If all the fins are lost, the fish floats belly upward like a dead fish. The tail or Caudal fin as it is called, by a strong and rapid side-to-side movement, gives the fish its rapid, noiseless, and forward movement through the water.

To enable a fish to travel through the water with the least resistance and splash, the body is covered with scales, or overlapping plates, resembling the tiles of a roof. and these plates are in their turn covered with a slimy, oily substance.

How a Fish Breathes.

As the fish lives and breathes in water, it has to be satisfied with a much smaller quantity of oxygen, than would satisfy the land or aerial animal. Its blood therefore is not in such large quantity, and is not so warm as the blood of animals and birds. In consequence its vitality is lower, and therefore its feelings and senses are said to be less acute, and its brain smaller and



less developed than in the case of animals and birds.

But a fish in order to live must obtain some of that staff of life—oxygen, or pure air—and it obtains this in a very interesting manner. As you know, there is a certain amount of oxygen in all water, and the whole principle of a fish's breathing apparatus, is to obtain from the water, instead of from the air, a sufficient quantity of oxygen to support its life.

If you take a fish in your hand and lift up the flaps at the side of its head and look inside, you

will see that underneath them there are a number of slits, and that the colour of these slits is red. The slits are called the gills, and the red appearance is caused by the blood that flows into the gills.

The fish in opening its mouth draws in the water, and in closing its mouth it forces the water out over the gill slits, under the flaps of the head, into the water again. But in doing so the gill slits have extracted the oxygen from the water, and the blood which flows into the gill slits has been supplied with it. The blood thus purified with oxygen flows as life-giving blood, and feeds all parts of the body.

The heart of the fish, which is of simpler structure than the heart of animals and birds, is situated near the throat, and pumps the blood by means of channels, into the gill slits. The blood having reached the gill slits, is supplied by them with the oxygen which they have extracted from the water that the fish has taken in by its mouth.

The fish's *mouth is so constructed that when* the water flows into it, it need not swallow any. But when the fish desires food, by closing up its gullet, it can feel it floating in the water in its mouth, and can so arrange its system of breathing and swallowing, that it can swallow the food, but not the water itself.

In other words, its system is so arranged, that it can extract its food and oxygen from the water that flows into its mouth, use this food and oxygen for its own benefit, and reject the waste water, less oxygen and food, through the gills at the side of its head; and it can perform all this without being compelled to swallow one drop of water.

Digestion and Senses.

Fish as a rule have large stomachs, and generally speaking are fond of a mixed diet, that is a diet of insects and smaller fish, combined with a diet of green stuff. But there are some fish, like the Pike, which are Carnivorous, that is, feeders that live mostly on flesh. There are others on the other hand, like the Tench, Carp, and Roach, which are herbivorous feeders, that is feeders which live mostly on a vegetable diet.

In consequence of fish like the Pike feeding on smaller fish and other moving things, the digestive organs of their stomachs have the power of dissolving very quickly any prey that may find its way there. Some observers state, that so quick is this digestive process, that while part of a captured fish is dissolved in the pike's stomach, the other part remains whole in its mouth. The teeth of these carnivorous fish are very strong

and sharp, and the jaws very powerful to seize, bite, and hold its prey.

The Roach, Tench, and Carp, in consequence of being mostly herbivorous feeders, and feeders that extract their food by suction, have no teeth in the mouth, and are called by fishermen leather-mouthed; but they have teeth in the throat, and these teeth have broad grinding crowns. This indicates that they swallow their food quickly, after the manner of the Ruminants or Cud-Chewers, (cattle and sheep), and then grind or masticate it, at their leisure by means of these throat teeth.

That fish have very keen eyesight no one who has ever attempted to catch sight of them in clear water can doubt. They also possess certain powers of smell, because they will often smell their food before taking it; and that they have powers of taste is proved, by their rejecting any distasteful foods that they may, by accident, take into their mouths.

It is stated that their sense of feeling any vibration of the water is particularly keen. For instance your tread on the banks of a pond or stream sets up a slight vibration of the soil; this vibration of the soil is communicated to the water, and this vibration of the water the fish are said to feel.

Have fish keen powers of hearing? There

has been much controversy on this point, some anglers stating that they have, while others state that they have little or none.

The following facts observed by the writer suggest that they have the sense of hearing:

The writer once stayed at a beautiful Derbyshire village. At the side of the highway there was a shallow pond of considerable size, through which flowed a stream of clear water. The pond was stocked with a great number of large coarse fish, principally Carp. It afforded much amusement to the visitors to feed these fish, which took with great greediness any suitable food that was thrown into the pond. In order to provide this food, there were two penny-in-the-slot erections by the side of the pond, and when you put in your penny, a small quantity of compressed fish food came forth in tablets.

The writer went many times to the pond for the purpose of studying and feeding the fish, and directly the click of his penny was heard in the slot the fish gathered with great rapidity from all parts of the pool, in expectation of being fed.

This fact suggests not only that fish possess a sense of hearing, but that they also possess intelligence. Experience had taught the fish that directly they heard the drop of the penny in the slot, and the noise of the little tray that carried their food being drawn out, it signified something

to eat. Experience had taught them to connect the noise of the slot with food. It did not come naturally to them. It was not an instinct with them. They had to learn it, and learn it from experience, and that denotes intelligence.

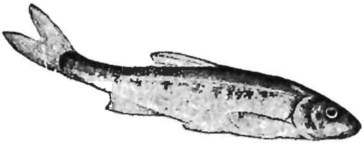
Colour.

There is no colour that you see, whether it be the colour of an animal, bird, insect, leaf, or flower, that does not serve some useful purpose to its possessor or to others; if the colour harmonises with the surrounding colours amidst which the creature lives and moves, it enables it to escape the notice of its enemies. Sometimes the colours are for purposes of ornamentation, and therefore serve as signals of attraction. Sometimes colours serve as danger signals, because they denote that the possessors of those colours are dangerous to be interfered with—but sometimes quite harmless creatures, for purposes of deception, are clothed with the same colour or tint of colour as the dangerous ones, and this imitation is often the means of saving their lives.

The whole subject of colour in the animal and vegetable world is a life study in itself, and one filled with the deepest interest. At present we have only touched the fringe of it. The facts that we have already discovered seem however

to point to this law—that every colour is of some use to its possessor, or of some service to others.

You must all have noticed that the colour of most fish harmonises with the stream or pond in which they have been reared and in which they live, so that it is often very difficult to distinguish them in the water from their surroundings. Most fish appear lighter in colour from beneath



THE MINNOW. (About $\frac{2}{3}$ Nat. Size)

than they do from above. If an enemy is looking up from beneath, this light colour enables them to be seen less readily. If the enemy is looking from above, the dark colour also serves to hide,—protective coloration, as it is termed.

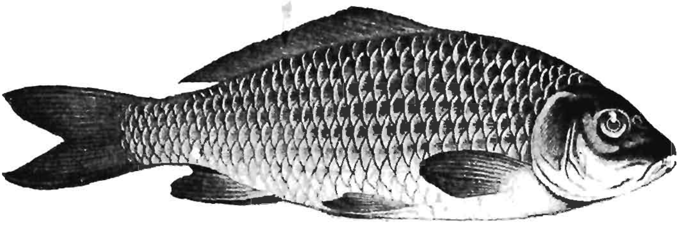
Trout taken on muddy and weedy bottoms, differ in tone of colour from trout taken on bright and clear bottoms. Most fish when they are very young are transparent, and are therefore invisible. You can at once understand how this serves as a protection.

The following fish are common to our ponds, rivers and streams: Perch, Tench, Roach, Carp, Pike, Eels, Stickleback, Barbel, Gudgeon, Dace,

Bream, Rudd, Bleak, Roach, Shad, Char, Minnow, Salmon, Salmon Trout, and Common Trout.

Carp.

You will now read a short account of the life-habits of some of our best-known fishes. We will take the Carp first, because it was the Carp that probably stocked the large ponds that were attached to the monasteries, country houses, and villages, in the olden times.



THE CARP.
(Sometimes grows to a large size, 3 to 6 lbs, are good fish)

The fish from these ponds, and especially the carp, largely supplied the demand for a fish diet, which the church in those days insisted that their members should eat during Lent and on fast days.

The Carp was then considered a very delicate fish to eat, and costly to buy, and was supplied to the table of princes. In consequence of the neglected condition of our Ponds, and the little attention paid to the cultivation of

our Pond Fish, the Carp caught to-day are often muddy in flavour, and flabby in flesh; but if a proper breed of Carp were introduced into our ponds, and the ponds wherever possible supplied with a stream of fresh water, and a suitable vegetable growth encouraged, the fish would then grow to a large size and become fat and good to eat.

Carp multiply very fast, they are hardy and will live for a considerable time out of water, and are therefore very suitable fish to transport from place to place. When they are three years old they spawn or lay their eggs, at the beginning of June. They generally prefer a warm sunny day, and they scatter their eggs, like poppy seeds, amongst the pond weeds. Their food consists of the soft parts of water plants, worms, and insects.

The carp is called by fishermen Leather-Mouthed, because it has no teeth in its mouth; the teeth are all situated in the throat, and have worn-down crowns, like the crowns of the molar, or side teeth, of quadrupeds This looks as if the vegetable portion of the food was swallowed hastily and in bulk, and then returned to the throat, there to be ground by the molar teeth. The Carp is a very long-lived fish, and takes a longer time than most fish to reach any weight. Some authorities say that Carp have

been known to live from 150 to 200 years, but how this is arrived at is beyond the writer's comprehension. In cold weather they appear to hibernate, for they lie dormant in the mud, and when in this condition no trace of food can be found in their stomach.

When they grow to a large size they are very difficult to catch. They are very cautious feeders, and will suck and nibble most guardedly before swallowing, and if there is anything suspicious about the hook, bait, or line, you will have very little chance of hooking your fish.

When they bite the line is slowly drawn out, an inch at a time; then if the fish discovers anything wrong it bolts, and you may find a large carp on your hook, and if so it will take you all your time to land it, as the fish is a hard fighter.

The baits to use are potato paste, and bread paste, sprinkled with a little aniseed. Worms are a good bait, and also boiled broad beans.

In muddy ponds, select the sandiest and most gravelly bottoms for throwing in your line, a hole between two weed beds is a likely spot.

In this country too little attention has been given to keeping the ponds as a healthy and clean resort for fish. The consequence is that the few fish that do inhabit them, are mostly muddy and insipid in flavour.

If the carp is to become, as it was in the olden times, a really nice fish to eat, our ponds must be cleared of the excess of mud, and the water must be fairly clear and not too stagnant. (A small rivulet of water running in, and an outflow of the same size running out will suffice.) Suitable vegetable growth must be also encouraged.

These improved surroundings would without doubt slowly improve our degenerated Carp.

But by far the best plan would be to introduce a fresh strain of carp, from places where they have been bred and reared under happier conditions, and in more suitable surroundings.

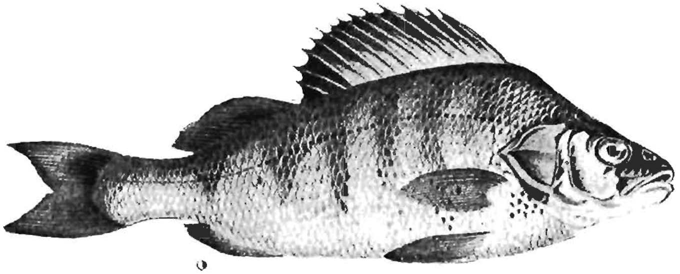
The Germans possess an excellent strain of carp, and the Americans, with their usual common-sense in seizing points for practical purposes, have of late imported great numbers of these German carp, for stocking their ponds.

The Perch

is one of our handsomest "coarse" fish, with its strong scales, broad stripes, and highly-coloured fins, but the hog back and big mouth rather spoil its appearance. They are found in our ponds, lakes, and rivers, and if these contain a fair quantity of food, the perch will attain a large size.

In small ponds where food is scarce, they will not grow to any size.

Under favourable conditions, at two years old they will measure about 5 inches. A perch of 1 to 2 lbs. weight is considered a good-sized fish. But they have been caught weighing 4 to 5 and 6 lbs., and in one case 9 lbs.



THE PERCH.
(Well grown fish from 1 to 2 lbs.)

At two years old they begin to spawn, and they deposit the spawn or eggs at the end of April or the beginning of May. This spawn is a very beautiful object to examine. It is a broad net-work band of pearl-like eggs, a foot or more in length, and it adheres to the bushes or weeds in the water. As each perch is said to lay 155,000 to 280,000 eggs a year, it is a great mercy that the ducks and swans, and their other enemies, are particularly fond of perch spawn, otherwise our ponds and streams would soon become a solid mass of perch.

The number of eggs in the following fish have been counted :

1 lb. trout,	- -	1,008	eggs.
4½ lb. jack,	- -	42,840	,,
½ lb. perch,	- -	20,592	,,
¾ lb. roach,	- -	480,480	,,
14 lb. salmon,	- -	10,000	,,
24 lb. ,,	- -	22,000	,,

Perch are very greedy feeders, and are therefore vigorous biters, do not strike at the first bob of the float under water, but let it sail well away and then strike.

Perch are fond of the worm, the minnow, and small gudgeon, and some fishermen use as a bait, a spoon with a red tassel of wool attached.

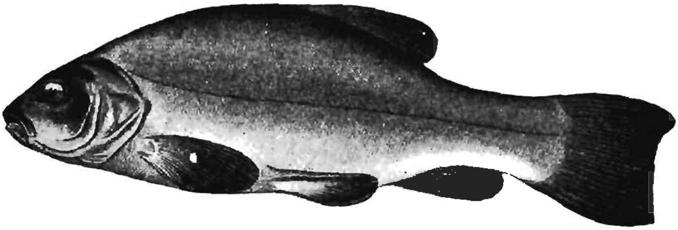
Tench are fish that will live and thrive better than any other fish in muddy, scummy, weedy ponds. They are happy amongst the thickest weeds, and they can live where there is hardly any water.

Deep clay pits filled with water and broad shallow water with muddy bottoms will support them well, but the pond must not be overstocked, or they will keep small and thin.

Opinions differ as to the flesh for eating; some people will not touch it, others say that a 2-lb. well fed tench, properly cooked, is one of the best eating fresh-water fish that we possess.

There is an old saying, that when the wheat is in flower in June, Tench spawn. The eggs are small, like poppy seeds, and like the eggs of the Carp, they are deposited on the weeds. The young fish grow rapidly, and at 12 months old weigh from ½ lb. to 1 lb. When six to seven years old they weigh 4½ lbs., a fish of large size in this country.

During the winter months they lie buried in the mud, and remain quite dormant. During



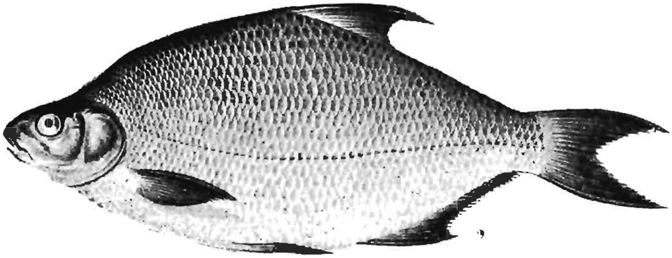
THE TENCH. (Grows to 4½ lbs.)

this period of rest, the stomachs of those that have been caught, have been found to be quite empty, therefore they are said not to take food during this period. They are slow feeders, but when they take the bait, take it quickly. An hour before daybreak is the best time to catch them. It is best to fish for them during warm muggy weather; they can be caught on hot days in shady places. When the float bobs up and down the fish are probably tasting the bait, and

when it sails away they have probably made up their mind to swallow it.

The best baits are worms, and lumps of bread paste.

Bream. These fish are common in lakes, canals, ponds, and rivers; they thrive best in large pieces of water. They swim about in companies



THE BREAM.
(A 2 lb. fish is a good catch.)

or shoals, and unless alarmed do not hurry themselves.

Bream are of two sorts, the Carp or Brown Bream, and the White or Silver Bream. The Carp Bream will grow as heavy as 10 lbs. whilst the Silver Bream, a much flatter fish, seldom exceeds 1 lb. in weight. The Carp Bream is dull in colour and narrow in shape, with a deeply forked tail, small head and large eyes.

This fish spawns in May; the flesh as a rule is soft, insipid, and full of bones, but when taken

in winter from a clear, gravelly, or sandy bottom, it is said to be good eating.

The Bream is a clean feeder, liking a nice, sweet, dainty bait, feeding delicately, and is not a glutton like the Perch.

When a Bream bites, the float gives a quick very gentle quiver, not a bob like a roach bite, but more of a shake; when you see your float giving this gentle quiver do not attempt to strike, because it is only the fish just lifting or touching the bait. When the float disappears slowly in a slanting direction, strike with a long sweeping stroke, not with a gentle up stroke, but with a long pull of the rod.

The best baits to use are bread paste with a little aniseed on it, gentles, red worms, grubs, and boiled wheat.

An excellent bait for many fish is the Caddis. Before the Caddis develops into a fly, it clothes itself in a beautiful suit of tiny sticks, and crawls about the bed of the stream with only its legs and head protruding. It is a comical sight to see a number of caddis thus crawling about; by stripping off this case you will find an excellent bait for many fish.

It is a curious fact, that the flesh of the Bream has a strong attraction for Wasps, for if you lay a dead bream in the open during the autumn, and there are Wasps in the district, they will

come from all quarters to feed on the fish, and so tenaciously will they attack it, that if you are not careful you will get stung. There is nothing better, or more handy, than the juice of an onion to relieve the pain and cure the inflammation arising from a wasp or bee sting.

Roach. The roach are shapely handsome fish, with golden red eyes, and fins tinged with red. When these fish are in condition in September and October, if nicely fried, they are very eatable; but at other times their flesh is soft and woolly. When a roach is at its prime it is deep and thick, and in the autumn and winter sunshine its thin, bright, smooth scales look like burnished silver. The best roach are caught in rivers, and to catch it is the most popular of all "coarse" fishing.

There is no fish that gives so much enjoyment in catching as the Roach. It is within the reach of the humblest angler, and because of the fine tackle necessary for its capture, it gives good sport.

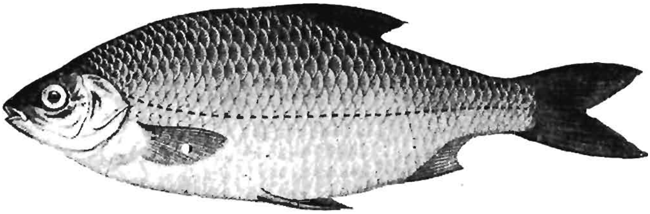
A 2 lb. roach is rare, and a 1 lb. roach is looked upon as a good fish. It is a very wary fish and up to all manner of dodges, and when the water is clear, and the fish shy, it requires great skill to land one.

Roach swim in large shoals, and when they are on the feed they can be caught in numbers. The

best time to catch them is during the evening, when it is warm and still.

In May they deposit immense quantities of spawn amongst the weeds, which the eels are especially fond of. In the early season they are found in sharp runs of water between reed beds, where they obtain a plentiful supply of insects or larvæ.

When the reeds rot, they move to deeper waters, frequenting eddies, mill-ponds, and slow-



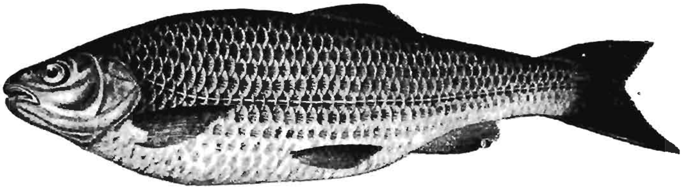
THE ROACH.
(A good sized roach will weigh about 1 lb.)

running deeps. When the water is high and muddy try your luck in the eddies that adjoin the main stream. A depth of two feet of water is at this time ample for the fish, and when they are found in these eddies they are often greedy for food.

Chub. These fish prefer a rapid flowing river with a gravelly bottom, but they will do well in a piece of water through which a stream flows. They are a wary and shy fish, choosing deep quiet holes, under bushes, over-

hanging banks, roots, and stumps. This fish has powerful teeth in its throat, which points to its being mostly a vegetarian. It is a very greedy feeder and easily frightened.

The bite of a chub is a very vigorous one, quite devoid of manners. When he does bite allow just one instant's law, then strike firmly with a long steady sweep of the rod right back. If you have hooked a chub the line will tighten instantly, and he will try to get in



THE CHUB.
(3 lbs. weight is a good fish.)

the weeds or willows, but do your best to keep him in clear water or you may lose him.

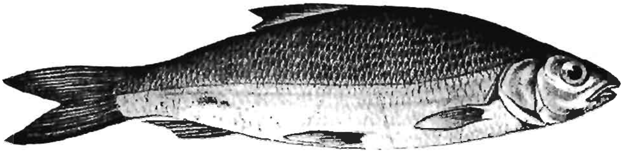
In the winter and spring, the chub is a firmer and stronger fish than he is during the summer.

The chub will take all manner of baits—cherries, cheese, beetles, log-worms, macaroni, moths, plums, mutton or beef-fat, bread, minnows, bleak, &c.

The Dace is one of the most elegantly-shaped fish that swims in our waters. It is of a silver whiteness, quick in movement, darting away

like an arrow from anything that alarms it. It is found in the clear wholesome water of our rivers, and lives in shoals like the roach, it feeds on the larvæ of various kinds of insects, and on worms.

The best dace are caught in very swift-running water. It makes a good fight for its life when hooked with a fly. It grows to a small size,



THE DACE. (Weight about 1 lb.)

a half-pound dace being rare, whilst a pound dace is very rare.

Besides worms, Dace will take "gentles," caddis, wasp grubs, and paste.

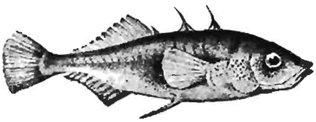
The caddis bait you have already read about. "Gentles" are the larvae of flies, and they can be obtained in the following way. In hot weather hang up a piece of meat or liver. Blow flies will soon find it out and lay their eggs in it, these eggs will hatch out in a few days into maggots, or gentles.

Stickleback.

You must all know this small, beautifully shaped, clever, plucky little fish, it is found in

ponds, ditches, shallow streams and canals, and if you tie a worm on to the end of a piece of string, and drop it in the water where these little fellows abound, one of them is sure to gorge it to such an extent that you can pull him out without the use of a hook.

If you place these little fish in an aquarium they will attack almost anything. Once a pike was observed to swallow a stickleback, but its sharp spines made the pike throw him up again in double quick time. In an aquarium the sticklebacks showed their objection to a pike by attacking his tail, which in consequence grew less and less, and at last the sticklebacks had to be turned out of the aquarium to save the bigger fish from further misery.


THE STICKLEBACK.
($\frac{2}{3}$ Nat. Size.)

They make a nest in the month of May, and a wonderful construction it is. It is composed of the decayed fibres of aquatic plants matted together into a mass, almost round, and placed at the bottom of the water, and covered with mud and sand.

At the top of the nest there are three or four circular holes; the eggs are of a brown colour, and about the size of small shot. The nests are difficult to find unless the eye gets accus-

tomed to search for them. The male protects the nest against the attacks of all other members of the family.

Once a male stickleback was removed while guarding his nest, and immediately some other sticklebacks began tearing it to pieces. After a time the male was restored to the water, and when he had recovered his senses he made for the marauders, drove them off, and then brought mouthfuls of weeds and bits of twigs, with which he repaired the nest, using his nose to hammer the materials together.

The male fish exercises paternal control over the young, and will not allow them to leave the nest till they are old enough to look after themselves. If a wayward youngster should break away from his restraint, the male stickleback will swim after it, and compel it to return to its nursery.

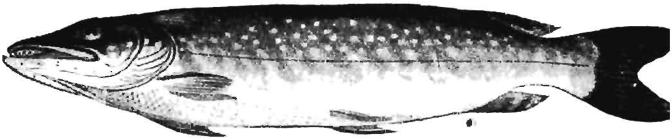
Pike

may be regarded as the fresh-water shark, for not only is the fish cruel in appearance, but cruel by nature. Like the fox it seems to kill for the pure sport of killing. No smaller fish seems to come amiss to it. Especially is it fond of that beautiful little fish the Minnow, and small Trout, Gudgeon, Dace, Roach, Bleak, and Goldfish. When they are hungry and food is scarce, Pike are said to eat one another.

The aspect of the pike is cruel. Its teeth are set to hold a fish firmly, and they point backwards towards the gullet. The long fang-teeth are inserted at each side of the jaw, and are something like those of a dog.

A finger caught between the teeth of a 3-lb. Pike will bleed freely, and it cannot without difficulty be withdrawn, unless the mouth is forced open.

The pike is in the best condition for eating from October to February, its flesh then being firm



THE PIKE (OR JACK). (Grows to a large size.)

and hard-set. In July and August they are thin and bony, and their flesh is soft, and insipid.

During windy weather they are on the feed. In still weather they do not seem inclined to move.

Sometimes during hard frosts good sport can be obtained. On cold days they lie in the deepest waters.

A likely spot for a pike is below a reed bed, either at the side or in the middle of a stream, or in a deep eddy formed below a reed bed.

When a large pike is hungry and his other food is scarce he will eat water Voles, Rats, young Ducks, young Goslings, young Moorhens and Dab Chicks.

The Pike spawns in March or April. The eggs, which are small, are distributed amongst the weeds.

A pair of pike will seek small bays, creeks and shallows, and deposit their spawn there, and will then return to the more open water.

Some pike grow to a very large size. A fish was caught in Scotland measuring 7 feet in length, and weighing 72 lbs.

In the county of Shropshire, in a large deep pond, a pike was caught weighing 72 lbs.

On the Continent a fish is reported to have weighed 145 lbs.

As you have read, the flesh of pike is good if they are taken during the winter months from lakes and large ponds, where there is plenty of their living fish food. If the pools are muddy and insufficiently stocked with fish, or the pike is caught soon after spawning time, it is worthless for the table.

You may take this as an accurate fact, that the food quality of the flesh of all fresh-water fish depends on the quality of the water they inhabit, the amount of food that the water

contains, and the time of year at which the fish are taken.

The usual haunts of the pike are the deep pools of slow-flowing rivers, and weedy ponds.

In the latter part of the 13th century, Edward I., who condescended to regulate the prices of the different sorts of fish then brought to market, so that his subjects might not be left to the mercy of the vendor, fixed the value of the pike higher than that of fresh salmon, and more than ten times higher than that of the best turbot or cod.

In the reign of Henry VIII. it is stated that a pike sold for double the price of a lamb in February, and a small pike for more than a fat capon.

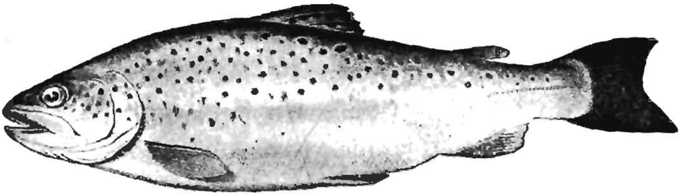
"In deep pools, shrouded from observation, in his solitary retreat, the pike follows with his eye the motions of the shoals of fish that wander aimlessly along. He marks the water rat swimming to his burrow, the duckling paddling among the water weeds, the dab chick and the moorhen leisurely swimming on the surface. He selects his victim, and, like the tiger springing from the jungle, he rushes forth—seldom, indeed, missing his aim. There is a sudden rush, circle after circle forms on the surface of the water, and all is still again in an instant."

In this quotation you have a vivid word picture of the pike.

Trout.

This beautiful symmetrical-looking fish, when first taken out of the water, glistens and sparkles with the bright colours of the rainbow. The shades of colour harmonise, and do not extinguish each other, producing such an effect that no artist could have conceived, and very few indeed can imitate.

The trout of our streams, the native Brown Trout is a voracious fish, but shy, cautious and



THE COMMON TROUT.
(From 3 to 4 lbs. is a nice sized fish.)

cunning, and it therefore requires great skill and patience, on the part of the angler, to land him.

The trout inhabits fresh water, brackish water, and salt water. The water that the fish inhabits produces a marked effect on its colour.

Trout with intense ocellated spots,—spots that resemble little eyes,—are found in clear rapid rivers, and small mountain streams.

In lakes with pebbly bottoms, the fish are

a bright silvery colour, and the ocellated spots are mixed with, or replaced by, **X**-shaped black spots. In brackish or salt water the fish is a bright silver in colour with few spots, none of which are ocellated. Some varieties of trout inhabit all degrees of water, even brackish, and therefore a great variety of colour is found amongst them.

The common brown trout is, as a rule, a non-migratory variety. Sometimes however, it migrates and descends to the sea, then the ordinary brown spots and trout coloration are exchanged for **X** spots and a silvery hue.

Trout spawn in November and December, and are said to live for 28 years, but they will not increase in size unless they can obtain a plentiful supply of food.

A trout was caught and confined weighing 3½ lbs. It was then fed on a plentiful supply of food, and in one year it grew to about 9 lbs. in weight. Its food was worms and minnows, and the entrails of a calf, finely cut up. There were other smaller trout confined with him, but when they swam out of their retreat to seek a portion of the food that was thrown in for them, the big trout drove them back again, and would not allow them to touch one morsel of food, till his own insatiable appetite was satisfied, 125 minnows forming the complement of his meal.

In the Thames, Trout are sometimes caught, weighing 15 to 16 lbs.; $\frac{1}{2}$ lb. to 1 lb. trout afford excellent sport to the fly fisherman.

When a fish is in good condition, its flesh is firm, and of a beautiful pink colour, and if it is caught out of a clear running stream flowing over a gravel bottom, there is no fish more excellent for the table.

Both salmon and trout spawn on shallow gravelly bottoms, because a rapid flow of water yields a good supply of oxygen, which is so necessary to the well-being of the eggs, and also to the young fry, or fish, when hatched out.

A trout nest is a mound of gravel, heaped up much higher on one side than the other, as if you had been scraping into the gravel with your heel,—the eggs are deposited a certain depth in the gravel. The coating of a fish egg is very tough and elastic, requiring considerable pressure to do it any harm.

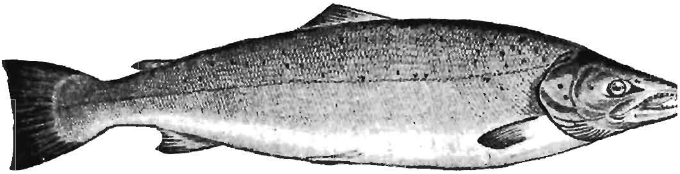
The female trout, to make her excavation or nest, is said to turn over on her side and do the work with her tail. As you know, it is much easier to turn soil under water than above it.

While the female trout is depositing her eggs in the nest that she has made, the male trout will defend her in very gallant fashion. When

he is thus on guard, he will rush after, with open mouth, and attack any male trout within sight, turning on his side to strike his blow, if blows are necessary to rout his enemy.

Salmon.

The Salmon is very justly called the king of fresh-water fish. When in good condition its flesh is pink and firm, very solid, and contains a great deal of nourishment. It is certainly a



THE SALMON.
(The Illustration represents a fish of about 20 lbs.)

very rich eating fish, and some people find its flesh indigestible.

It possesses, for its size, a lesser proportion of the small, awkward little bones that are generally common to the fresh-water fish. Perhaps the quantity of small bones, and the difficulty of getting rid of them when eating, is one of the reasons why fresh-water fish have grown into disfavour.

The salmon, on account of their size, do not live in our small streams, but in our large rivers, and these rivers must be in easy communication

with the sea, in order to allow the fish to travel to and fro to it.

The habits of the salmon are of profound interest, and they have been studied very carefully by a number of painstaking observers; still there is much left to learn of the life and habits of this wonderful fish.

The interest of this fish lies in its migratory habits. It spawns or lays its eggs in suitable spots or spawn beds, in our rivers, and then descends to the sea, in order to recruit its strength, and build up a store of reserve fat.

It is said that during the time it remains in our rivers it eats little, but that it lives on the fat it has stored up during its stay in the sea. Whether this is really so or not, is open to question, but the fact remains that when descending to the sea the fish are thin, weak and out of condition, while when ascending the rivers, after a stay in the sea, they are plump, firm and in excellent health; as one observer says: "They ascend our rivers tremulous with fat."

In the attempt to descend to the sea to their feeding places, and in ascending the rivers to their breeding places, they will overcome obstacles that would seem impossible for a fish to overcome. For instance, if in their journey from the sea they come across a waterfall several feet high, they will gather in the pool

at the foot of the fall, and from there make leaps over it. Sometimes of course they will miss their mark, and fall back exhausted, into the pool, not to discontinue their efforts, but to gather strength in order to try again and again, until they have succeeded. A salmon leap, when the salmon are on their migratory journey, is a sight which once seen can never be forgotten.

Salmon spawn in November and December. The female fish works out a furrow in the gravel with her tail in which she deposits a number of ova, or eggs. These she covers, by a renewed action of her tail, and continues the same process for three or four days until she has deposited the whole of her ova. The male fish protects the spawning bed.

More male salmon die than female, because they are such desperate fighters. An old male salmon is often caught scarred about the body with wounds, the result of hard fighting.

The young fish hatch out from 90 to 120 days after the eggs have been deposited.

At four months old, the average length of the young fish is about three inches, at twelve months, four-and-a-half, at eighteen months, five-and-a-half.

At two years old, the young fish resembles its parents, and is therefore practically an adult.

At fifteen months old (according to some observers this age varies from one year to three years), the young salmon, in order to attain strength and size, descend the river to the sea. When they reach the sea, owing to the great abundance of suitable food all around them, namely, Sand-Eels, young Herrings, Shrimps, etc., they grow very rapidly.

It is reported on fairly accurate evidence, that a fish was caught on its way to the sea, and it weighed 10 pounds. It was returned to the river with a distinguishing mark on it, and 37 days later, when it was ascending the river from the sea, it was again caught, and then weighed 21½ lbs.

Salmon ascend the river during the floods for the purpose of spawning, and they swim up either singly or in troops.

The early or clean run fish of the spring months, are in excellent condition, and very fat, the whole body of the fish being lined with internal fat.

Sea-fed Salmon are quite "tremulous with fat," growing thinner and thinner while in our rivers, deteriorating in quality till after spawning time, when they are exhausted and quite unfit for food. This is the period in a salmon's existence when the instinct of self-preservation teaches it that the health-giving sea, with its abundant

supply of food, is necessary to support its race in vigour.

Speaking generally Salmon pass the Summer in the sea; during the Autumn they push up the rivers; in Winter they inhabit pure fresh waters; in Spring they descend again to the sea.

It is stated that the female ascends the river before the male.

During the migration journey to the sea, after the exhaustion of spawning, many fish perish, and many when they reach the sea, fall a ready prey to Porpoises and Dog-Fish.

The same principle which causes the bird to migrate to foreign lands, forces the salmon to ascend and descend our rivers—namely, the primal principles,—to obtain food and to bring forth young.

As you have read, some authorities state that while in our rivers the Salmon does not feed, or feeds very sparingly. If this be so it must live a semi-hibernating life, like the bear that goes into winter quarters quite fat and comes out quite thin. Salmon have been caught, 70 lbs. in weight, and 4 feet 8 inches long. A 20-lb salmon is an excellent fish and one not often caught.

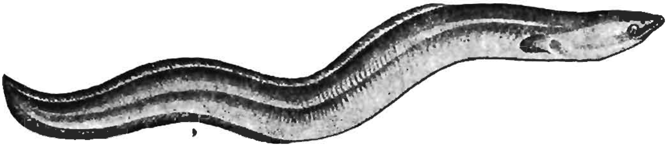
No salmon caught in English waters is allowed to be sold from the 2nd of November to the 1st of February.

Before Cathedrals were built Monasteries were

established. The founders of these monasteries often selected sheltered spots on rivers, where the Monks could obtain a plentiful supply of fresh-water fish, especially the Salmon, for the use of their table during their periods of fasting.

Eels.

There is perhaps no food about which there is so much difference of opinion as there is about the flesh of the Eel. Some people have a



THE EEL.

repugnance to it as food, while others have a great liking for it. You all know the Eel of course. In appearance it is the snake of the waters.

There are two varieties of Eels found in this country, the common Eel, and the less common Broad-Nosed Eel. The Broad-Nosed Eel is a very coarse feeder, devouring any kind of sewage and refuse, and it is therefore at all times unwholesome as food. The common eel when taken out of clear water, is the one eaten by those who are fond of the eel. The best eel is very rich in fatty matter, and is only suitable for strong diges-

tions, and therefore ought to be eaten in small quantities. As an old writer quaintly expresses it, "Grant them never so good, excess is a venomous sting in the most wholesome food."

Henry I., King of England, died of a surfeit brought on by eating too many stewed lampreys, which are a species of small eel, that attach themselves to stones by their mouths.

Eels migrate, but they reverse the habits of the salmon. Whereas the salmon ascend our rivers to lay their eggs, and descend to the sea to fatten themselves and recruit their strength, the eels reverse the process, by descending to the brackish or salt water to lay their eggs, and by ascending our rivers for their food.

After the little eels have been hatched out in the warmer brackish waters of our Estuaries, they ascend the rivers in countless myriads, and so desperate are their efforts to reach certain points in our rivers, that they will climb up and over any obstacle in their way,—the upright posts of waterfalls, or the moist rocks at the side of the falls.

One observer states, that he noticed the pool under a waterfall blackened by myriads of these little eels, about a finger in length, constantly working their way up the moist rock at the side of the fall. Thousands died, but still over the dead bodies of their comrades the little creatures strove on, keeping near the side of the stream

easiest of ascent, sometimes combining together to form a long rope, sometimes in shoals, sometimes each for itself, every now and then diving under the sand, or resting under the shelter of a stone.

The matured eels that descend our rivers in search of their spawning beds, begin their movements on dark nights, when the rivers are in flood, or when the stream is flush with water. On light nights, we imagine for purposes of protection, they will not move, but the darker and more stormy the night, the more readily will the migration towards the sea take place. This is the time to set your Eel traps.

Eels eat sparingly in cold weather, but in hot weather they are very ravenous. Their food consists of fish of all kinds, Worms, Spawn, and Insects. Fortunately for our fishing, the eel has many enemies, Otters, Polecats, Herons, Swans, Pike, and Salmon, are all very fond of the rich flesh of the eel. When eels lie dormant, as they do in the winter, in holes in the mud, rats will make attacks on them.

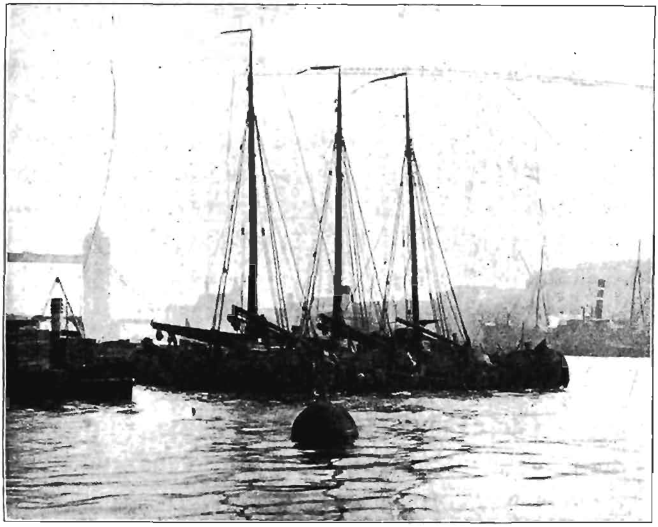
That large weird bird with long legs, that you must have sometimes seen waiting immovable, for an unwary fish, the Heron, has a claw particularly adapted for seizing and holding a slippery eel. A good-sized Eel is however a nasty customer to tackle. It is recorded that

once a Heron seized hold of an Eel by the middle, and sent its beak through both of the Eel's eyes, but the Eel in self-defence wound its body around the neck of the Heron, and they were both found dead together.

The London market is supplied with Eels largely from Holland, where they abound, 10,000,000 finding a market annually in our capital. If you lean over London Bridge with your face towards the mouth of the Thames, you will see a wonderful sight of commercial bustle and movement. Steamers, barges, warehouses, all playing their part in the great and complex machinery for supplying the millions of London with their food, drink and clothing. From all climes, and to all climes, the laden steamers come and go, to ship or to unship their cargoes into barges and warehouses. And thousands of human hands of every nationality, are engaged in this important work of interchanging and distributing the products of the world.

Amidst this bustling and interesting scene, your eye will perhaps rest on the old-fashioned Dutch boats, of 16th century pattern, lying side by side, moored off Billingsgate, the great London fish market. On that spot, boats of the same type have been so moored, since the day when one of the Charles' gave them a free charter of the River.

In the holds of these old-fashioned Dutch eel boats there are tanks of muddy water, the surface of which is black with the countless



DUTCH EEL BOATS LYING OFF BILLINGSGATE MARKET.

In Hollar's *Long View of London* showing Old St. Paul's from the Thames, two of the eel boats appear at anchor.

heads of struggling eels. A boat from Billingsgate comes off with an order for eels, and the slow-moving Dutchmen, with long-handled landing net, and scoop, take the Eels from the tanks, and with their scales give the weight necessary to satisfy the order.

Show Mercy.

Fish, breathing in water, only require a small quantity of oxygen, therefore the blood remains cold, and the vitality and the energy of the senses are less acute than are the senses of animals or birds. Their brains are very small, they are dumb or nearly so, their eyes are motionless, their face bony and fixed, their limbs incapable of flexion, moving as one piece, thus giving no index of their feelings. Their ears it is said, can only hear general sounds, as they live where all around is silent. The eyes are fixed in a continual stare. All their surroundings can affect them only in a confused manner. To lay their eggs, to pursue a prey, or to escape an enemy, and to do it all in a most effectual manner, amidst the surroundings in which they find themselves, is the life-work of a fish. With very few exceptions they build no nest, nor do they care for their young. They deposit their eggs and then leave them to their fate.

Although the feelings of fishes must be distinctly less acute than the feelings of most other living and moving things, feelings they undoubtedly have, and therefore when you catch

them, grant them and the live bait, if you use it, whether it be worm, fly, or small fish, as much mercy as you can.

The Enemies of Fish.

You must have noticed, and have asked yourself the very natural question, why does a fish lay such an enormous quantity of eggs, in proportion to the number that hatch out, and the still lesser number that grow into good-sized fish.

If you consider the many dangers that fish are exposed to, especially the enormous destruction of their eggs that takes place, it will at once occur to you that the laying of so many eggs is a necessity, if the race of fish is not to be quite extinguished.

You may take it as a general rule, that the greater the dangers the eggs or young, of any practically defenceless form of life, are exposed to, the greater is the number of eggs produced, or the young born.

The eternal laws that through such long ages, with such infinite patience, have evolved all the varied forms of life that you see around you, are jealous to preserve every suitable form of life from extinction.

Now let us consider some of these dangers. In times of drought the eggs are exposed and left high and dry out of water, and so the life

within them perishes, or the eggs themselves are exposed to the many birds that are always on the look-out for such an excellent dinner. In times of flood the eggs are often washed out of the nest, or away from the spawning beds, and are either eaten by other fish, which are always on the look-out for them, or the life within them perishes in the rush and turmoil of the water. Many fish will even eat their own eggs. Trout are great sinners in this respect.

Once 500 trout eggs were taken from the mouth of one trout, and being placed under suitable conditions were hatched.

Common water-shrimps will eat the eggs of fish as rats will eat grain in a stack.

There is a well-known fly called the May fly; it appears early in the season, and when it hovers over the water the trout will rise to swallow it with great eagerness. This is a great reversal of things, for the larvæ of this very fly are the deadly enemies of the egg of the trout, as well as of the egg of the salmon. The larvæ of this May fly fasten on the eggs of the fish, piercing them with their sharp nippers, and in one instant, the egg turns white and is dead. 70,000 salmon eggs were once placed in a small pure stream for the purposes of hatching, and they were all destroyed by the larvæ of the May fly.

The larvæ of the dragon fly are also great destroyers of fishes' eggs, and they are justly called the "river tigers."

House rats are especially fond of fish eggs.

Ducks are most destructive to spawn. You cannot have ducks and spawn together; you must give up one or the other.

Swans may be ornamental, but they are of no use for any other purpose. Certainly they are most destructive to fish spawn. A careful observer says that the Swan will eat spawn as soon as the fish have deposited it, and he calculates that the Swans on the Thames are responsible for the loss of 1,000,000,000 fish eggs a year.

It is calculated that only one salmon egg out of every 1000 deposited by the parent fish, becomes a fish fit for human food.

How to Convert a Useless Pond into a Useful One.

Hundreds of acres of lakes and ponds in this country, which are now earning no money, might with a very little expenditure, be made into profitable abodes for fish, and afford endless amusement, healthy recreation, and wholesome food for dwellers in the country.

As you have read, in the olden time fish-ponds were attached to the manor houses and

monasteries, in order to supply fish during the fast days, when the eating of meat was prohibited.

In those old days, before the introduction of the railroads, and before the keeping properties of ice were known, it would have been impossible to convey, with promptitude, fish from the sea ports, to the inhabitants who dwelt inland.

The slow-moving coaches, the bad condition of the roads, the dangers of being attacked by highwaymen or robbers, made the conveyance of articles from one place to another a difficult, dangerous, and expensive undertaking.

Every locality was obliged to produce what it required in a far greater degree than it does now; every district had especially to produce its own food, and find the material for building its own houses.

The introduction of railways, the great improvements that have been made in the building and handling of fishing boats, and the improved methods of catching sea fish, and when they are caught, of placing them on the different central markets, and the connection of these markets, by a net-work of railways, with the different cities and towns of the kingdom. These changed conditions have caused a less demand for fish out of the nearest fish-pond, and so

the ponds have been neglected, and are now mostly filled with mud and rubbish. The few fish that are found in them have in most cases deteriorated in quality and have become muddy, flabby, and insipid in flavour, much more so than they would have done had they lived under better conditions.

In certain parts of Western, Central, and Southern Europe, the conditions that prevailed in this country in the old days still rule, and so a superior pond cultivation is still carried on. Pond cultivation of fish in this country is a forgotten art, but an art that might be restored with great advantage to the inhabitants both of the country and of the towns.

If possible, in the autumn, drain the water from the pond, dig out the bottom mud or slime that you will probably find there, and place it on the land, for it makes excellent manure. Then when possible, leave the pond dry for the summer, because when you introduce the fish again, it is then in a good condition for them to breed in.

The pond need not be too deep, in fact we are told that a shallow pond is best, provided it contains a few deep holes for the fish to take refuge in.

Fish like shallows, and small fish must have the shelter of stones; shallows are needful to

breed insect life, and insect life is a necessity to the fish.

If possible grow rushes and water plants. A useful and effective plan is to place common hurdles on the pond, fixed in one spot by posts, which are driven into the bottom of the pond. This simple plan will enable the fish to attach their spawn to the hurdles; and the hurdles will also serve as Hides, for there is nothing more important than that fish should have places in which to hide themselves. Keep the leaves of trees away from the pond, for when they decay on the top of the water they sink to the bottom and create mud.

If you wish your fish to grow to a large size, your piece of water must not contain too many of them, and you must feed them. The more you feed your fish the quicker they will grow. A good plan is to hang up a dead cat or a dead rabbit over the pond; the blowflies will soon find it out and lay their eggs in the carcase, and from these eggs maggots will hatch out, and falling into the water will be eaten greedily by the fish.

In the evening after a fall of rain, by the light of a lantern, collect the worms that the moisture will tempt from their hiding places. You must tread carefully and softly, or the worms will feel the vibration caused by your tread, and will wriggle back into their holes.

A worm catcher, who has made a most successful business of catching and storing worms, and supplying them to anglers in all parts of the country, says: "To be a successful worm catcher you must have long arms and a soft tread, because you can then stand still, and bending over, can catch the worms without moving about much." If you wish your worms to be in good condition for angling, place them for a day or two in some damp field moss. How long a worm keeps suitable for a bait depends on the weather, but as a rule it cannot be kept more than a week.

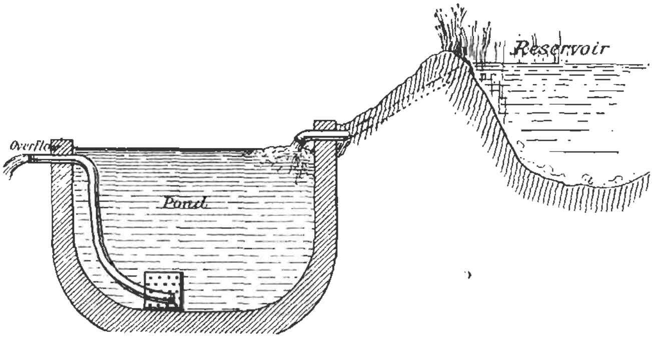
In feeding fish always feed at the same spot, and you will find, that after a little time, the fish from all over the pond will come to that spot, and await your visit with great eagerness.

If possible let a stream of water, no matter how small, flow in and out of the pond. This will keep the fish in sound health, and firm condition, and in consequence they will taste less muddy and insipid, than they would taste if the water of the pond were stagnant.

In case a stream cannot be obtained to flow naturally into the pond, the writer makes the following suggestion: Where the ground is suitable, above and close to your pond, dig a small reservoir in the ground that will collect

the surface rain-water from the surrounding land, and from which you can drain a stream into your fish pond.

The writer has seen no more simple or suitable system for keeping the water of a pond free from stagnation, than the principle shown in the following plan.



THE WAY TO KEEP A POND FREE FROM STAGNATION. (After Frank Buckland.)

PASTURES.

THERE are three classes of grass land:

I. *Permanent, or grazing pasture*, which is used entirely for grazing stock, and is seldom, or never mown.

II. *Mowing permanent pasture*, which is reserved year by year, for mowing and making hay, and which at certain times of the year is grazed.

III. *Temporary pasture or seed pasture*, land which is sown with clover and grass seeds, and left down to grass for two, three, four, or five years and then ploughed up again.

Let us consider each of these classes of pasture in turn.

Permanent Pasture.

When permanent pasture has been down for a certain number of years it is sometimes called an old turf. If the old turf is well established, and has been treated carefully and well during its growth, is well drained, and filled with nourishing

grasses and clovers, which should cover every inch of its surface with a good face, or level bottom; such an old turf is a very valuable possession to both Landlord and Tenant.

It takes many years to establish such a Turf, some farmers say ten to fifteen years, others say much longer. Most of the valuable old turfs of this country have not been disturbed by the plough during the memory of man.

The length of time required to establish permanent pasture depends on many things, such as the slope of the land to the sun, its drainage, the quality of the soil, and the preparation in the first instance of the seed bed. Then the selection of the seeds, the conditions under which they were sown, and the manner in which the young grass and clover plants were treated when they were young and delicate, and the way they have been treated since. If through neglect or inexperience, skilful treatment has not been meted out to the young pasture, many years of waiting may end in disappointment, and considerable sums of money may be lost.

You can therefore understand how difficult it is to obtain the consent of a landlord to plough up an old pasture.

Every device known ought to be tried to restore health to a pasture before the plough is

put into it. It must be ploughed up only as a last resource, and when everything else has failed. From his own experience and as the result of experiments, the writer is of opinion, that the most worthless pasture, provided it is well drained, either naturally or artificially, can with skilful treatment be resuscitated or brought round, and become a paying piece of pasture land.

Seeding down a Pasture.

Preparing the land for the sowing of permanent seeds is half the battle, it requires a great deal of experience and careful work if a successful future is to be assured.

The prepared soil, or seed-bed as it is termed, must be in a fine state of dryish subdivision, with no clods of earth about it. It must be cleared not only of weeds, but if possible—a more difficult matter,—of the seeds of all weeds. It must be made firm and solid, so that the tender roots of the young grasses and clovers can take a firm hold of the soil. It must contain a sufficient quantity of manure, available plant food, and moisture, so that the young grasses can feed, live in health, and grow with vigour.

To sum up, the seed-bed must be made a comfortable home for the young grasses, for many years to come.

This condition of the seed-bed must be brought about by ploughing, harrowing, scarifying, rolling, and manuring.

When the seed-bed is level, some farmers plough, or scarify, and drag with a harrow two or three times during the summer preceding the laying down of the pasture; the final operation taking place in the early spring.

This is done to improve the physical condition of the soil, to destroy the weeds and the seeds of weeds; and to convert the dormant plant food that is in the soil, into suitable nourishment for the grasses to take in by their roots; to preserve moisture, so that the soil will be sufficiently damp to supply the nourishment that the grass-plants require, in liquid form. All plants take in their food in a liquid condition from the ground, by their roots.

At the present time, when the profits on farming are cut so fine, Farmers cannot as a rule afford to sow Grass Seeds by themselves, so they prepare the seed-bed in the same manner as before stated, and then sow a straw crop, Oats, Wheat, or Barley, and soon after the sowing of the straw crop, they sow the Grass and Clover seeds, so that when the straw crop is harvested, the Grass and Clover seeds have got hold of the ground, and have grown to a certain size and strength. The Straw Crop is sometimes called

the Mother Crop, because it acts as a protector to the young and delicate Grass and Clover Plants.

Drainage and Site. Before preparing the seed-bed, it is essential that the field should be well drained. If by its position and slope it drains naturally, so much the better, if not it must be drained artificially, and that is often an expensive undertaking.

Good drainage allows the atmosphere to be carried into the soil, and prevents the fatal accumulation of stagnant water. The oxygen of the air sweetens injurious substances that are in the soil.

It does not matter how much raw plant food there is in the soil, if it is not in such a state of combination and liquid preparation, that the plants by their roots can take it in, it is practically useless. Air, rain, and sunlight enter the soil, and are necessary forces for converting the locked-up food that is in the soil into suitable food for the plants to feed upon.

But stagnant water, or soil not properly drained, prevents these natural forces from entering the soil, and the plants in consequence suffer.

Drainage checks a too rapid giving-off, or evaporation, of the moisture in the soil, and thus it is kept warm and comfortable for the plants.

Drainage also promotes the early and late growth of the grasses, and this is of enormous

value in feeding stock. If the land is sodden with moisture, the cattle, by their hoofs, inflict injury on the grasses, and the first slight frost checks their growth.

Heavy loam and clayey soils are more suitable for the formation of permanent pasture than sandy and gravelly soils. If you have two fields, one facing north and the other south, for preference lay down the field facing north, because there is less chance of its being burnt up in summer.

Good Seeds Essential.

In laying down your land to permanent pasture, it is essential that the seeds should be bought from a seed merchant who has a name for honest dealings, and whose seeds have a reputation for being clean, and free from the seeds of weeds, and a large proportion of which, when sown will grow, and continue to grow with strength and endurance.

If you are not careful about this very important matter of purchase, you may sow what you think are good clover and grasses, and instead there may appear a large proportion of troublesome weeds; or if the seeds have not a high vitality, as it is termed, the majority of those sown may not appear above the ground.

Don't economise in buying seeds. See that you get value for your money, but it is the cheapest plan in the long run to pay a good price for the best seeds that are to be bought.

If you are near a grass and clover seeds warehouse, it is worth your while to go over it.

The seeds of the grasses are very minute and chaff-like, and so light that a very slight air will blow them about.

In these seed warehouses you will see the different grass seeds stored in their own special sacks, with the names plainly marked on the outside. If you put your hand into the sack and take up a handful of the seeds, they will appear to be quite clean—that is, they will appear to be free from any other seed or dirt that should not be there. This result, as you can imagine, is not attained without a great deal of trouble and expense.

The grass and clover seeds are generally grown in France and Germany. A responsible member of the firm goes over every year, and it may be buys up crops of the different Grass Seeds, which have been grown specially for the purpose of providing seed for the seeding down of Grass land. These Grass Seeds are shaken out of the ears, on the same principle as the Wheat and Oat grain is shaken out of the Wheat and Oat ears.

After the seeds arrive at the warehouses, from the countries where they have been grown and harvested, they are examined carefully, and by means of the most delicate machinery everything that ought not to be there is sifted out.

A certain number of the sifted seeds are then tested under glass for vitality, and a certain number are also tested in the outdoor trial plots, which all seed merchants of repute have attached to their businesses.

The test for vitality is as follows: A number of seeds are counted and then sown, and the number that appear above the ground are also counted, and this counting shows the proportion of those that appear above the ground, to those that were sown.

This may give you some idea of the amount of trouble, and expense, taken to secure clean and healthy seeds. But if this trouble is not taken, you may buy seeds that are largely mixed with the seeds of weeds and other rubbish, and so a crop of weeds may appear above ground, and if the Grass and Clover seeds themselves do not possess a high vitality, a large proportion of those sown may never start to grow.

Settling a Pasture.

Each spring there ought to be a careful inspection of the young pasture and the young plants,

in order that all bare patches may be re-sown. The entire surface of the ground *must* be well covered. If a few inches are bare, needless evaporation will take place. If the grasses are kept too short, the rays of the sun will take up much of the soil moisture which ought to be at the disposal of the growing herbage.

The field must be constantly chain harrowed and rolled, and for the first few years, it must have a slight dressing of manure,—well-made Farm-Yard manure for preference—applied in the autumn.

Probably one reason why land laid down to Permanent Pasture so often fails, or takes so long to become established, is because of the neglect to manure slightly every year, when the grasses and clovers are young, and require coaxing and delicate feeding.

After a field is once laid down to grass, for the first few years it is far better to manure it slightly every year, than to give it a single heavier dressing when it is older.

A slight dressing every year slowly builds up the health and vigour of the plants, and so there is less chance of their dying out.

When a well-sown Pasture begins to fail at a critical period, namely in three or four years, it is probably owing to mismanagement or starvation.

Briefly stated—the essential conditions to establish a good Permanent Pasture are as follows: Suitable soil, effectively drained, and well situated. Seed Bed thoroughly prepared and sufficiently manured. An abundant supply sown of mixed healthy Clover and Grass seeds, and Manure or Plant-food applied, as the young Grass and Clover seed need it.

ANNUAL MEADOW GRASS (*Poa Annua*).
Stems 6-12 inches.

At the very best, it takes several years of watchful care to make sure of a permanent pasture. It has been well said that "The eyes of the farmer make the grass thrive."

Preserving a Pasture.

There is an old and very true saying, "Manure your land through the mouth of your stock," and this is certainly the best manner of keeping your Permanent Pasture in good heart. Graze it with mixed stock, not keeping one

variety of stock on any one piece of land too long at a stretch, because if you do it will impoverish the pasture, and your stock will not do so well. Stock require change of pasture as we require change of food, if we are to keep in health. Pasture also, if it is to be maintained in good condition, requires change of stock, and at times a complete rest from all stock. Sheep will feed on growths that cattle will pass over, and horses will eat growths that both sheep and cattle will pass over. So between the three classes of stock, a pasture may be grazed close. Grazing alone will soon impoverish a pasture. Cows take away from the soil, nourishment that they turn into flesh, bone, muscle, and milk, and which they do not return to the land. Bullocks and sheep take away nourishment that they turn into flesh, bone, muscle, and wool, and this finds its way into the butchers' shops, and therefore is not returned to the soil.

If your pasture is to be kept in good heart, something must be done to replace the plant foods, which the stock have taken out of the land by their consumption of the herbage, and which they have not returned to it.

The most profitable plan is, while your stock is grazing, to feed them with some concentrated food that will restore to the soil some of the

plant food which the stock have taken away from it, and have not returned to it.

This *concentrated food* is generally given in the form of corn and cake, and the chemist tells us that the animals only use up one-tenth of the plant food contained in the corn and cake, so that nine-tenths of it finds its way into the soil, and so supplies a store of plant food that the grasses in due time can feed on.

Therefore the corn and cake given to stock while they are grazing, not only fattens your stock and helps your milking-cows to give a more abundant flow of rich milk, but at the same time, and what is of supreme importance for the future well-being of your land, it manures the soil, and so lays up a store of plant food, which enables the grasses to grow strong and vigorous.

But something more must be done. Your pasture, when it is well established, must be chain or bush harrowed at least once a year, though twice is better. This harrowing spreads the droppings, and so prevents the appearance of unsightly rank patches of grass. It drags out the moss, and thins out the weaker and dying grasses, and so allows the air, rain, sunshine, and manure to penetrate the soil. It also sweetens and corrects the acidity of the soil.

Then again, your pasture should be rolled once or twice a year, because the rolling causes the

roots of the grasses to spread and grow together in a compact and even manner, which will give the pasture "a good face," as the expression is.

Try to get all weeds out of the Pasture, cut your thistles down before their winged seeds or thistledown fly about. In most farm agreements, the tenant undertakes to cut the thistles down once a year, before they seed, but if the thistles are to be really weakened, they must be cut down several times during the year.

In addition to feeding stock upon it, and applying the general treatment described, it is sometimes wise to stir up an old pasture by giving it a top dressing of good farm-yard manure, or a dressing of some artificial manure.

Beware however, of artificial manures. Large sums of money have been lost by the Farmers of this country, by the application of Artificials which the soil did not require. An extra crop was not forthcoming to compensate for the cost of the Artificial Manure applied to the land; or the Artificials have not been what the sellers have represented them to be. In buying Artificials, insist on receiving with them an Analysis from a Chemist of knowledge and honesty.

Farm-yard manure, where the stock of the farm has been liberally fed, and where the

manure heap has been wisely made and preserved, is by far the safest and most valuable of all manures.

Many an old pasture is not doing as well as it should, because it is hide-bound, which means that its growths are so matted together with moss, weeds, and rubbish, that the rain, air, sunlight, and manure cannot penetrate to the roots of the good grasses. In cases of this kind, a severe harrowing with a sharp-toothed harrow, followed by a roller has often done much good.

The sort of manure to be used must depend on the chemical condition and position of the land, its past history, and the experience and judgment of the farmer who has knowledge of the land he is farming.

To know the kind and quantity of manure to apply, so that the land will give a profitable return, is one of the secrets of successful farming.

If the cost and labour of manuring an acre of ground is, say, 20s., and the extra return for the expenditure is only 18s., then a loss has been incurred. But if the cost of the manure and labour is, say, 20s., and the extra return for this expenditure 25s., then a clear profit has been made. The farmer who can accomplish this, has learnt one of the great arts of his work.

The more good and nourishing grasses you

have growing in a pasture, in a compact and even form, the greater the number of stock it will fatten, and the larger quantity of rich milk it will produce to the acre.

You may have pasture land dear at 15s. an acre and cheap at £3 ; it altogether depends on the condition of the land, the chemical composition of the soil, the history of its past and its proximity to markets.

Hints on Grazing.

In grazing a pasture there are two objects in view, namely the progress of the stock, and the fertility of the soil. In dry summers, a smaller quantity of dry sun-fed grass, will do more good to the stock, than a much larger quantity of wet and sodden grass.

When there is sufficient "feed" of Spring Grass, without the extra addition of much hay, and the ground firm enough to prevent their hoofs damaging the young shoots of the grasses, it is best to turn out your stock from their winter quarters.

When the grass becomes too old the stock refuse it unless very hungry.

Some pastures, that grow a strong and rather coarse variety of grasses, are often ready earlier for the turning out of stock, than those pastures that grow the finer and later varieties.

Sheep feed very close to the ground and therefore keep the grass very short, but as the grasses begin to grow young stock should be added, as they will feed off the longer grasses and flower stalks, which the sheep will pass over.

Pastures that are especially suited for fattening bullocks, are often not suitable for the grazing of sheep. A perfect sheep pasture should not contain grasses long enough for the fattening of bullocks.

The ordinary pasture can be best fed, by a combination of bullocks, young stock, horses, and sheep. The proportion of sheep should not be so great as to taint the pasture.

This mixture of stock feeds the crop down evenly and so benefits the pasture. By changing the animals from field to field a change of diet is insured, as no two pastures have exactly the same herbage. Each animal has its likes and dislikes, and so between them, they will eat a pasture clean.

Calves need the best grasses that can be given them, and they do best when turned out to pasture apart from other stock.

A first-rate bullock pasture is not suitable for milking cows, because a bullock pasture tends to fatten the milking cows too rapidly, and so they lose in the power of producing milk.

Fat beasts often become dainty and leave a lot of herbage ungrazed; then it is best to turn into the pasture a herd of lean store cattle. These half-grown young beasts will soon eat off the herbage that the fat dainty bullocks pass over.

It is wise to start Stock in the worst pasture first, and then change it for the better.

Stock if placed on inferior pasture after a good one will soon lose flesh, and this means a loss to the farmer.

If fattening stock are doing well they will lie down a great deal. If they do not quickly satisfy their appetite, they cannot put on flesh.

Some farmers after the harvest, run the sheep for a time over their stubbles; this plan gives their grazing land a needed rest.

Grass should be eaten down close before the cold and frosty weather sets in, but sufficient herbage must be left to ensure a luxurious growth the following spring.

Cattle in the autumn will eat with relish much coarse grass that they refuse in the spring. Frost sweetens and makes coarse tufts palatable. If these tufts are not eaten down before Christmas, they ought to be mown.

Low lying meadows are suitable for feeding cattle.

Upland meadows being less rich in herbage, are best grazed by sheep, and moreover these upland meadows, being as a rule drier and better drained, are less liable to give the Sheep "Foot Rot."

Old pastures are best for fattening stock—newer ones are best for feeding calves and young stock.

In the south of England the pastures are ready to receive stock about the beginning of May; further north the pastures may be about a fortnight later. Don't forget—in the Spring and Autumn, to Chain Harrow the grass land.

The droppings of cattle ought to be scattered at least twice a year. If they are left till late in the year a quantity of grass is lost to the farmer, because the droppings, if left for months and not scattered, will kill the grasses underneath them, and the grass that grows round the droppings becomes rank and sour.

All stock should be able to procure a plentiful supply of fresh water.

It is desirable that stock should be able to obtain shelter from the hot sun of summer, and the cold winds of winter.

Therefore it is advisable to grow trees in clumps, scattered about the fields for this purpose.

Trees grown in hedgerows are not to be recom-

mended, because they kill the hedge underneath their shadow, and keep the road that they overhang damp, and afford little or no shelter for cattle.

A thick compact hedge is often a great protection to the stock from wind and rain.

Cattle and horses will stand to the leeward of a hedge, and if there is a heavy rain before a high wind, it is wonderful what protection they will obtain in this manner.

Horses specially seek this method of protection.

Some horses will prefer standing in the open, with their tails against a hedge, instead of seeking the protection of a shelter.

It must be very bad weather indeed before some horses will seek the shelter of a shed.

Roughly constructed wooden sheds facing south, will protect the stock from biting east winds and violent cold rains. Suitable temporary sheds can be erected with a few wooden uprights, having the roof covered and three sides built up with the trimmings from the hedges. These shelters can be put up at very little cost and trouble. All stock should be able to get at lumps of rock salt.

Permanent Mowing Meadows.

In order to avoid confusion, it is best to call land that is used solely for grazing "Permanent

Pasture," and land that is used year by year for mowing "Meadow Pasture."

To maintain Mowing Pasture in good heart, so that year after year it may produce an abundant yield of nourishing herbage, which can be turned into good hay, requires even more attention, and more abundant manuring, than does a grazing pasture.

In a permanent pasture the stock, especially if they are fed with some Corn, Cake and Hay, return to the land much plant food, which they have taken from it. They not only manure the land, but by their constant treading improve its texture or physical condition.

On the other hand a meadow that is regularly mown, is robbed year by year of much plant food, that finds its way into the Hay Stack, which is perhaps sold off the Farm. If this goes on and no manure is supplied to restore the plant food to the soil, the yield of Hay will not only lessen in quantity or bulk, but gradually it will become of an inferior quality.

Remember that if you manure wisely, and keep your land in good condition, the nourishing grasses and clovers will grow at the expense of the inferior grasses and weeds; but if you fail to manure, and your land is farmed in a slovenly manner, the inferior grasses and weeds will gain the upper hand.

Applications of Dung and suitable Artificial manures, not only compensate for the exhaustion of the soil, caused by the mowing of the herbage and making it into Hay, but they encourage the growth of the desirable grasses.

Water meadows are mowing lands, which by a system of water-courses and sluices can be flooded at certain times of the year; but the water, if it is not to do harm, must not remain stagnant. When the meadow has been well saturated, the surplus water ought to drain away by channels cut for that purpose.

FLOATING SWEET GRASS
(*Glyceria Fluitans*).
Stems 1-3 inches.

The herbage of water meadows, although very luxuriant, is often inclined to be rather coarse, and of a softer nature than is desirable.

In permanent pastures you can hardly have too many Grasses and Clover plants, but in a Mowing Meadow if there are too many plants crowded together, they will not grow to their full

size, and many of their leaves in consequence of being deprived of sunlight will become yellowish and insipid, and lacking in that beautiful smell that good all-round Hay should possess.

The lowland meadows will grow many natural grasses that the upland meadows will not grow, and for this reason it is easier to lay a low-lying piece of ground down to grass, than a piece of ground that is situated at a higher and drier level. Owing to the luxuriant growth of low-lying meadows, care must be taken that the growths do not become so matted together as to exclude air, rain, sunshine, and manure, from making an entrance into the soil.

If this crowding together of undesirable growths continues too long, the herbage will become so sour that the stock will refuse to eat it, and any hay that is made from it will be of an inferior quality and will hardly be worth Harvesting. In that case, a good harrowing *with a sharp-toothed harrow, and after that an* application of some manure, such as Basic Slag, will cause the better grasses to grow, and will probably sweeten and pull round the whole meadow. If this and any other remedies known to experience and science fail, then there is nothing for it but the plough. But plough only in the very last extremity.

TEMPORARY OR SEEDS PASTURE.

A RACE of men, farming the land generation after generation, surrounded by their families and their few labourers, and living somewhat isolated lives, must have observed many important facts, the reasons or causes of which they could not account for.

For instance many farmers when going through their fields, can point out the good Feeding Grasses, and inferior Grasses and Weeds, but in many cases they cannot name them, nor can they tell you their chemical constituents. They have arrived at this knowledge by observing that certain growths are eaten readily by their stock, while other growths are left severely alone. They may also have noticed that in certain of their fields their stock will do much better than in other fields. The stock will fatten more readily, or the milking cows will give a more abundant flow of rich milk. The growths and condition of these fields, have become familiar to the observant farmer's eye, and so as he walks along he

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can point out the different growths, pronouncing on them his praise or his blame.

The inquirer, the experimenter, or the scientific student then comes along, and learning the fact from the experience of the farmer, he endeavours to find out what causes the fact; and in his researches he has often shown the farmer how he can improve on his method; and very often his researches cause him to light upon some great and fresh discovery.

Experience, for a very long time back, had taught the farmer, that if one year he grew a clover or bean crop and then ploughed it under, the next straw crop was benefited considerably by what he had done.

His experience had taught him, that the clovers somehow manured the soil for the succeeding crops, but how they did it he did not know.

His experience had taught him the fact, but he was ignorant of the cause that produced the fact, or the cause for the effect.

Modern knowledge has now proved that the root crops, and the straw crops, take nitrogen from the soil, while the clover crops add nitrogen to the soil; and this knowledge has further shown us in part how the wonderful work is accomplished.

At the roots of all the Pea Family, Clover, Bean, and Lucerne, etc., there has been dis-

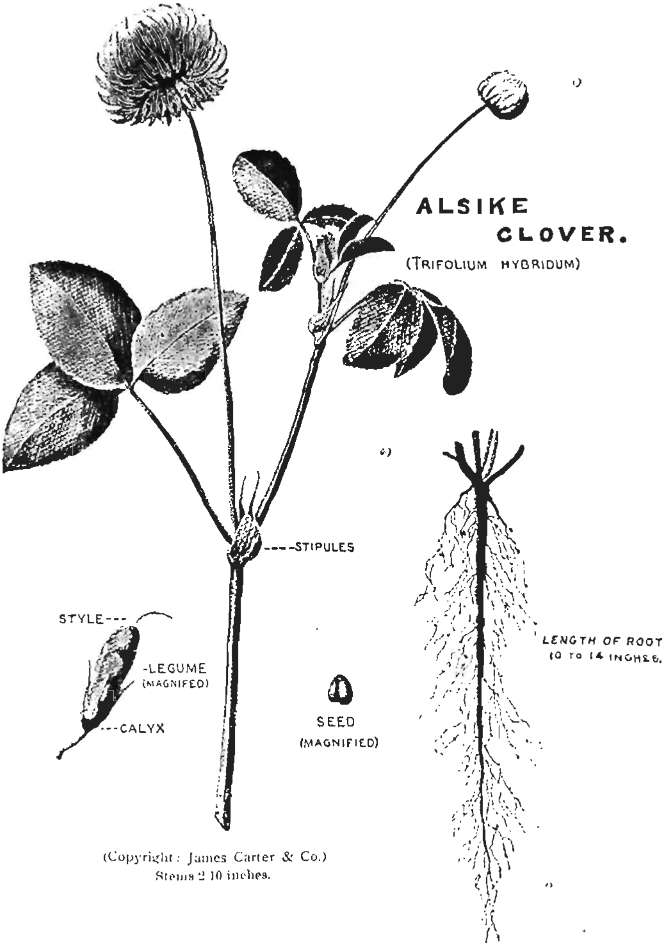
covered little nodules or lumps, and these little lumps or nodules are inhabited by minute Germs or Bacteria, and these Germs somehow or other have the power of seizing upon the ammonia in the air and in the soil, and converting it into nitric acid, and this acid combining with the lime and other substances in the soil, becomes one of the soluble foods for future generations of plants.

Remember that crops must have nitrogen in the form of nitric acid or nitrates, and if the soil is deficient in this nitrogen food then the farmer must apply it, either in the form of farmyard manure, or by means of artificial manures; and if he has to buy it as an artificial, it is a very expensive matter indeed.

Preparing and Sowing.

In order to obtain a crop of Clover Hay, it used to be the practice to sow Broad Leafed Clover seeds amongst a grain crop, and the next year to plough the Clover under, but now it is found to be better for the land, and more economical for the Farmer, to sow mixed seeds of Clover, Rye grasses, and other grasses, and to keep the whole down for two, three, four, or five years, before ploughing under.

The plants generally sown are White, Alsike, and Broad Leafed Clovers ; Cow grass; Perennial, and Italian Rye grasses ; Cock's-foot ; Fox-tail ;



(Copyright: James Carter & Co.)
Stems 2 10 inches.

Timothy; and Meadow Fescue grasses. If the seeds are only to be kept down for two years,

then the mixture of seeds consists almost wholly of Clover and Rye grasses, but if the seeds are to be kept down longer, then there must be sown a larger proportion of Grasses and White Clover, because these plants cover the ground and possess a longer life, and will yield an abundant supply of rich herbage for several years.

Before the seeds are sown the land must be clean—that is free from weeds and rubbish, and well drained. The seed bed must be in a fine state of subdivision, and must contain a sufficient quantity of ready made and available plant food, to supply the growing seeds with the nourishment that they require.

The seeds themselves must be clean and strong in vitality, and the mixture of clover and grass seeds must be in their right proportions. A quantity of the seed that is sold contains valueless Goose-grass and Yorkshire-fog, with a liberal sprinkling of Sorrel and Dock.

The man who sows rubbish will assuredly reap rubbish.

When the seed-bed is in good condition, it is sown in the Spring with a light straw crop, and after a short time, the clover and grass seeds are sown. When the straw crop is harvested, the grass and clover seeds will have taken good hold of the ground and will have grown to a considerable size. And if the Summer has been a bit

showery and the young grasses are robust, in the Autumn young stock and sheep may be turned amidst the young grasses and clovers, and they can then obtain an excellent "feed."

In the Spring of the following year, the young seeds ought to be bush harrowed and rolled, and then rested, or laid in, to allow the Hay crop to grow.

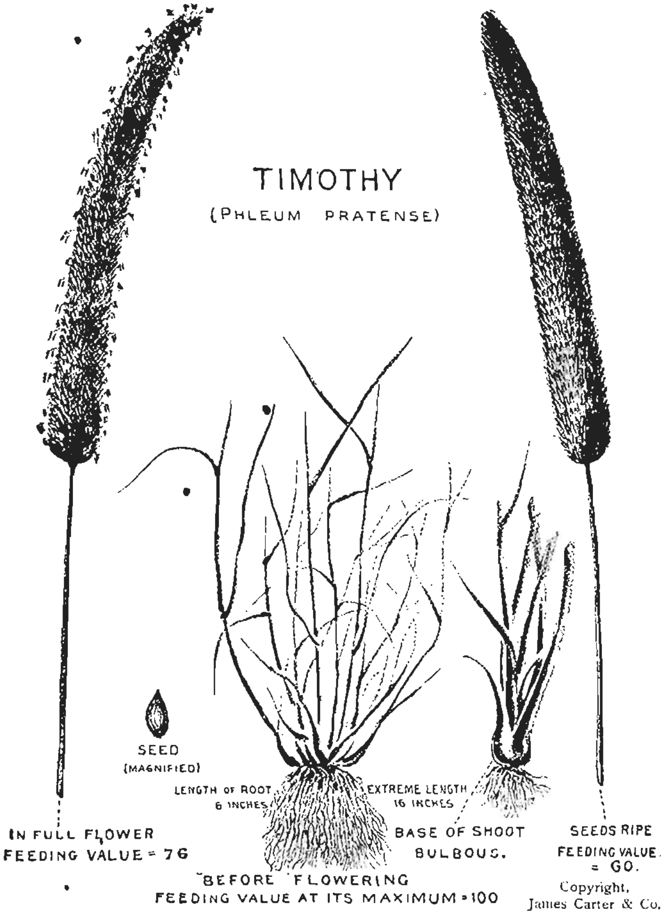
After the hay crop has been harvested, the land is grazed, and the following years it is mown or grazed, according to the judgment of the farmer, till it is finally ploughed under.

When the seeds are ploughed under, the ground is made rich in Nitrates from the action of the Bacteria at the root of the Clovers; and the droppings of the animals that have been grazed over it, add to the soil a supply of Potash and Phosphates. So the Seed Pasture has not only produced excellent crops of Clover Hay and luxurious grazing for stock, but the Ley, as it is sometimes called, when ploughed under, stores in the soil plant food for future crops to feed on.

A dressing of cake-fed farmyard manure, applied towards the end of the first year to the young Clover and Grass Seeds, will very considerably strengthen and improve the herbage.

It is stated by some authorities, that the fresher the manure that is placed on the ground,

and the less it has been allowed to ferment, the



better will the grasses thrive. One point however is quite certain, that the manure applied

ought to be spread direct from the manure cart, and not allowed as is often the case, to stand in heaps for days, and even weeks, before being spread.

Clover Hay is especially valuable for feeding milking cows, and the cart horse.

A successful farmer of considerable experience once told the writer, that he considered a feed of well-made clover hay for his cows and horses, equal to a feed of the ordinary hay with a feed of corn thrown in.

Benefit of Laying Land Down to Seed Pasture.

Much of the lighter soil of the country will not go down to Permanent Pasture; at first it may do well, but after a few years the Grass and Clover Plants will die out, and the pasture will fail. But much of the lighter soil that will not keep down to Permanent Grass, will go down for two or three years to Seed Pasture. In the present condition of agriculture, it is as well to have as small a proportion of the farm as possible under the plough.

To grow wheat and the other straw crops, at the present prices, does not pay, and Farmers have to turn their attention principally to the production of Milk, the making of Cheese, and preparing Stock for the Butcher. To do this they have to farm their land, so that it will

grow the greatest amount of "feed," at the lowest cost.

Many farmers now think, that laying a portion of their arable land down to seeds for a few years, is the most paying and the most effective method of present-day farming. The best system of farming is to have one-half or two-thirds of the farm under Permanent Pasture, and a half of the remaining Arable portion down in Seed Pasture, retaining the other portion of the arable land to grow sufficient roots to feed the stock during the winter, and to produce sufficient straw to bed the stock down, and be turned into good farmyard manure.

There is another point to be considered. A farmer who has a certain quantity of land under Seed Pasture, would be able to take advantage of any improvement in the price of the cereal crops, by ploughing his seeds under, and growing on the ground excellent straw crops.

You must have noticed that Cereal Crops are generally heavy when grown after a two or three years' Ley. It is important that the straw of the grain crops should be as strong as it can be grown, to enable the crops to stand up against rain and wind, which almost always comes when these crops are in ear.

If the straw is weak these storms will sometimes beat down the oat and barley crops (wheat

stands up better) as flat as a pancake, and then the loss in grain is considerable, and the cost of cutting and harvesting much increased.

Thin crops with small yielding ears, stand a much better chance of keeping themselves erect against storms, than do the thicker crops and heavier yielding ears, unless their straw is strong in proportion to bear the extra weight.

The Hay Crop.

The difference between harvesting a crop of cereals, namely Wheat, Barley, or Oats, and harvesting a crop of Hay is this. In a crop of cereals the great object is to get most of the strength of the plant into the grain, and out of the straw. In a crop of hay the object is to keep all the strength of the plant in the straw, and not to allow it to go from the straw to form the grain or seeds.

In the Straw Crop it is the Seed that is eaten, but in the Hay Crop it is the Straw that is eaten.

Therefore the grasses and clovers must be cut before their seeds form, and the herbage must be made into Hay before the nutriment in the stems disappears. On walking through a field of mowing grass if the pollen dust flies about, it shows that the herbage is ready to be cut.

Much of the grass in this country is cut after the grass seeds have formed; in consequence the Hay itself, that is the Hay Stems, have lost a large proportion of their nourishing properties; in other words, the saccharine or nourishing part of the straw has found its way into the seeds.

The earlier made hay not only contains more nourishment, but is more digestible than the later made hay.

The great majority of the grasses, especially the Clovers, contain nearly double the amount of nourishment before the seeds are formed, than after they are formed.

True it is that the earlier cut Grasses shrink more than those cut later, but this shrinkage is principally owing to the escape of moisture, therefore it is not of much consequence.

In a pasture that is used for grazing most of the year, it is imperative that the grasses should follow on at different times of the year, some giving early herbage, others midsummer herbage, others autumn herbage. But in a pasture that is used for mowing, it is best that all the grasses and clovers should arrive at their flowering stage about the same time, so as to secure the greatest weight of herbage of a uniform quality.

Bulk for bulk, the herbage near the ground is more valuable than the growths at the top, therefore stones, rubbish, and impediments should

be removed from a mowing pasture, so that the Machine or Scythe can cut as near the ground as possible.

Hay-making. As has been said, the great aim in making the most valuable Hay is to retain all the nourishing parts of the grasses and clovers in the stems, and to get rid of the excessive moisture of the green herbage, so that the hay may smell sweet, be dry and crisp, and keep and improve in the stack.

To convert green herbage into well-made hay it must be deprived, by the evaporation of its moisture, of nearly three-fourths of its weight.

This moisture must be got rid of by exposing the green herbage to wind and sun.

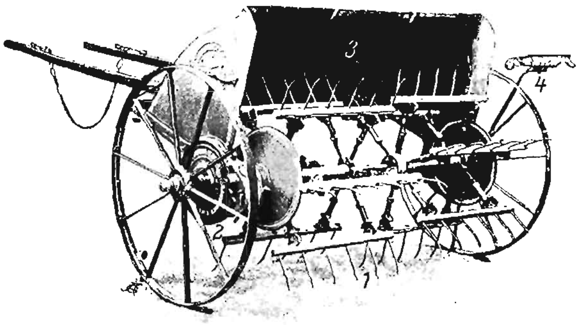
In our uncertain and dripping climate, it is most difficult to make good Hay. If the grass is kept out too long in dull, showery, or wet weather, especially if the Hay be half made, it loses a part of its goodness, and if it is stacked when moist, or when it is not well made, it will deteriorate in the stack.

Greenness and crispness, with a sweet lavender smell, is a sign of good hay. But if it has a brown shade, whether resulting from too long exposure to rain or sunshine, it is a sign that it is of inferior quality.

Inferior quality may also mean that the hay is composed of too many inferior plants, or it may

mean that the saccharine or nourishing part of the good plants has left their stems, and has caused the bulk to become woody and indigestible, and deficient in smell.

In "model" weather if there is a sufficiency of labour, and other conditions are suitable, Hay can be made in three days, and if the herbage be



TEDDER.
1, Tines; 2, gear box; 3, hood; 4, driver's seat.

composed of good feeding Grasses and Clovers the quality ought then to be first rate.

The steps are as follows: 1st day, the grass is cut by a Mowing Machine, and falls into a long straight line of green, or Swathe. These long thin lines of grass are then scattered about by the Tedder or Fork, so as to allow as much of the herbage as possible to be exposed to the ripening and drying influence of the sun and wind.

Towards the evening, if the atmosphere is very dry, the Tedder should be sent over it a second time.

2nd day, the drying herbage must be horse-raked into rows, and then the Tedder must be set to work along these rows, so as to throw them into thin beds of about four yards wide. In the evening these beds ought again to be drawn into rows, and the rows in their turn made into large Cocks. The reason for Cocking is to afford the herbage a protection against rain, and also to allow the ground all around them to become dry. No hay can be made if the ground is wet.

3rd day, when the dew is off the ground the Cocks should be rolled over, so that the ground underneath the cocks may be allowed to dry. When as much of the hay as can be carried is turned over, it must be thrown out roughly from the cocks, and then the machine should be set to work to gather it into rows again, and from the rows it should be pitched on to the Hay cart and carted into the stackyard.

It is very seldom that hay can be made in such a short time as this. Unsettled weather, and it may be scarcity of labour will prevent it.

But these are roughly the principles of hay-making; the carrying out of these principles depends on the state of the weather, the aspect

and condition of the field, and the amount of labour at the disposal of the farmer.

The green herbage is spread out in order that its moisture may be got rid of, by the ripening and drying influence of sun and wind.

If the weather is uncertain, only such a quantity should be dealt with that has a prospect of being harvested in good condition.

If the grass is left undisturbed in Swathes, as it is cut, some rain will not do it much harm; it is when it is partly made into hay, alternately dried and wetted, that the principal damage is done.

In Merioneth and North Wales the general practice after the hay has been cocked, usually, in the case of average crops, on the second or third day, is to cart and stack it. It is seldom found necessary, except after heavy rains, to spread out the cocks a second time.

Dry or "benty" grass, which does not contain much clover, will almost make itself into hay in fine weather, and there is little fear that it will ever fire in the stack. On the other hand grasses with large succulent stems, that is stems full of moisture, are less easy to turn into Hay, and if not carried in good condition are very likely to fire in the stack.

An old and safe test as to whether Hay is fit to carry, is to gather together a few of the stout stems and twist them into a rope, and

if moisture then exudes the crop is not ready to carry.

Great care must be used in stacking a crop which contains a large proportion of Clover, as the stems of the clover contain a quantity of moisture.

The herbage should be treated as gently as possible, and not knocked about too violently, because the outside of the grass and clover stems are covered with a delicate coat of waxy matter called silica, similar to the bloom on the stem of wheat, and similar to the beautiful bloom which covers the surface of a peach. Somebody has called this coating--very expressively—"Nature's waterproof mantle."

In tossing the grass about too violently this covering is broken, and so any rain that may fall during the first two or three days after the grass is cut, instead of merely moistening the outer surface of the cut herbage, will soak into the stalks themselves, and do much harm in washing out valuable feeding matter.

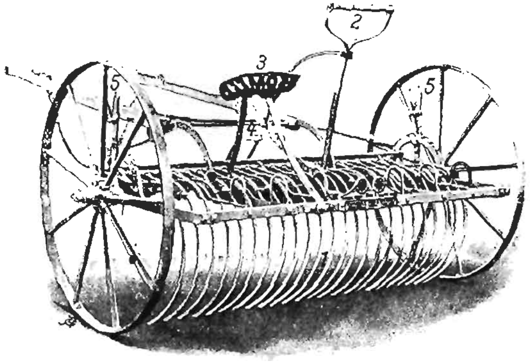
By knocking about the grass too violently the stems are broken, and this allows the water to enter them, thus setting up decay.

Some experienced Haymakers state, that with the utmost care, the Tedder knocks about the herbage too much, and so they maintain that the best Hay—all other conditions being equal—is

made on the old-fashioned principle, namely with the fork and rake.

In continual wet weather the cut grass should be allowed to lie undisturbed, it will take less harm than if it is moved about.

The Tedder must never be used to make clover hay, because the machine knocks off the Clover



HORSE RAKE.
1, Teeth; 2, lever; 3, driver's seat; 4, treadles for automatic delivery 5, levers for adjusting the teeth.

leaves, and so, much of its good feeding properties is lost. Clover must be turned, worked, and spread gently with the fork, and with the greatest care.

If the Hay has been harvested early, and the weather has not been too dry, an abundant second crop of herbage, or Aftermath will grow.

There is an opinion that the Aftermath, if

harvested, is of a higher quality than the earlier growths.

But making the Aftermath into Hay is very uncertain on account of the heavy dews, the shortening days, and the succulent nature of the herbage, and moreover, it is a great drain on the vitality of the grasses and clovers of the meadow.

In the opinion of the writer, it is best for the land, and best for the next year's crop, if the Aftermath is fed off by suitable stock.

No matter how carefully the Hay has been carried and the field horse raked, a small quantity is sure to be left behind, and some careful and economical farmers will turn stock into the field to eat up what remains, and to browse on the patches of herbage left standing around the hedges and ditches. Directly this "feed" is consumed, the cattle are driven from the field in order to give the Aftermath a chance to grow.

Stacking Hay.

The Ricks or Hay stacks should not be built directly on the ground, but placed on a layer of rough faggots, so that the stack can obtain plenty of ventilation. If a rick is built directly on moist ground, it will absorb moisture like a piece of sugar placed in tea.

The best shape for a Stack is square. The

oblong shape exposes too large a surface to the atmosphere. The roof should be at such an angle that it will allow the rain and snow to shoot off it. If it is built any higher than is necessary, there is a tendency for the rain and snow to injure the upper portion of the Hay. The bottom of the Stack should be less wide than the eaves, so as to allow the rain draining off the thatch to clear the sides of the stack. In building a stack the centre should always be higher than the outside, and every layer as it is pitched on the stack should be trodden down firmly.

When there is a fear that the hay is not quite dry, and that in consequence it may fire in the stack, it is best to make ventilating shafts by pulling out armfuls of hay.

Perhaps the better method is, when the hay is being stacked, to place layers of dry straw between thicker layers of hay; the straw will then absorb moisture from the hay, and will also absorb much valuable juice from the hay and clover, and the whole will make an excellent "feed" for home consumption.

Weathered Hay, that is Hay that has been repeatedly soaked and dried, until much of its valuable properties are lost, will be improved in quality, and made more palatable to stock, by sprinkling common salt over the layers of the

rick, as the building proceeds—ten to twelve pounds to each ton of hay.

Except under long-continued rains, very little chemical change takes place when the herbage is left out in the open, it is principally in the stack that the change takes place. When the hay is stacked, a certain amount of heat is always evolved, and this heat, acting on the starch of the herbage, converts it into sugar, and some of the sugar in its turn gets converted into alcohol and carbonic acid gas.

Not only does good hay depend on the quality of the herbage, and the conditions under which it has been made, but a great deal depends on the amount of heat evolved after the hay has been stacked.

Overheating on the one hand blackens or chars the hay, and so makes it sour and not nourishing or acceptable to stock.

Underheating on the other hand causes the hay not to ripen sufficiently in the stack, and as a consequence the herbage loses much of its sweetness, crispness and digestible qualities.

When a stack heats, the middle of it is browner than the outer parts. When some stacks are cut, you may often see a dense brown patch, almost black, in the middle. This is a proof that the hay has heated too much.

You should be able to go round a stack, and

pushing your hand into it as far as you can get it, pull out handfuls of hay, and then you should be able to distinguish the superior grasses and clovers, and the inferior grasses, and the wholly worthless growths or weeds. And if you find that your handfuls contain a very large proportion of good feeding grasses and clovers, that it possesses a nice sweet lavender-like smell, and that it is of a uniform pale-green colour, and crisp to the touch, you may then be almost sure that the stack from which you have gathered those handfuls is composed of valuable feeding hay. Such a stack does credit to the farmer who has succeeded so well in accomplishing such a difficult piece of farm work.

GOOD FEEDING GRASSES.

THE order of grasses called "Gramineae" includes a very wide range of plants. It includes the crops called the Cereals and the crops called Grasses. It includes Wheat, Barley, Oats, Rye, Maize, Rice, and Millet, all of which are cultivated for the sake of their grain; and it includes Meadow and the Pasture grasses, which are cultivated for the sake of their foliaged stems.

If you examine the root of the grass plant you will find that it consists of threads, called Root Fibres. These fibres in some cases, such as Barley, spread near the surface in search of their food; in others, such as the Wheat, they penetrate more deeply into the soil for the same purpose; while with other grasses the plants root themselves in the same way, and then spread over the surface by means of Creeping Stems or Stolons.

Above ground the upright stem is called the Culm. The culm is hollow save at the joints, where it is solid. Its texture is very flinty and strong. In fact it would seem impossible to

imagine a stronger and more suitable structure for its purpose, than these hollow solid-jointed stems with their flinty-like make, to bear erect the seed and to bend without breaking before the outbursts of wind and rain.

Some grasses, instead of growing by root-fibre alone, spread by prostrate Stems or Stolons, which as they draw away from the main stem, send rootlets here and there into the ground, and stems upwards into the air, thus giving rise to a number of independent growths.

This principle of growth, as you can understand, spreads and covers the ground in a much more effective manner, than is the case with those grasses, that send their roots deeply downward and chiefly in one spot.

The leaves of grasses are as a rule long and narrow, growing to a point at the free end, and embrace the stem at the other end by a Leaf Sheath, the point of its embrace being called the Ligule.

Parallel ribs extend from the tip to the base of the leaf. In most cases the Leaf Sheaths are split down the front, some of them being rough and some of them smooth.

It is very difficult to distinguish grasses by their leaves alone. It is easiest done when the plants flower, or grow into the ears or Panicles.

The flowering of all the grass family follows

much the same principle. The flowering of the Oat represents it very clearly.

At the end of the nodding structure of the Oat there are delicate branches called Spikelets. At the base of these Spikelets there are two large boat-shaped leaves called Glumes. Between the Glumes grow two or more little Flowers or Florets. Each floret has at its base two Chaffy Leaves opposite to each other.

What is a Good Feeding Grass? It is a grass that the stock will eat readily, keep healthy upon, and which they can convert with little difficulty to themselves, either into milk or into meat. The good and useful grass will withstand heat and cold, wet or dry, frost or snow, and will cover the ground or bottom, with an even carpet of green, showing no brown or bare spaces between.

In the hay field the grasses ought to grow with rapidity and strength, throwing up a quantity of nourishing and digestible herbage, and a herbage specially thick at the bottom.

The grass heads ought to seed as nearly as possible together, for as you have read, the farmer requires in his hay crop all the strength of the plant in the stalk, and if the grasses are cut when the pollen flies from them—that is, just before they are forming their seed—this object will be attained.

But if the seeds have ripened, the strength of the grass plant has found its way out of the stems into the seeds, which lessens the value of the Hay crop.

In the grazing meadows however, it is as well that the grasses should not all flower at the same time, but that they should flower at different seasons of the year—some in the early spring, some at midsummer, and some later in the year.

How to Encourage Useful Growths.

Any one who knows the useful feeding grasses, from the worthless feeding grasses and growths by sight, must be struck by the number of useless growths found in most of the fields in this country. This of course means that the acre does not feed or support all the stock it might.

The great object of skilful grass farming is to eradicate, or to get rid of these worthless growths, and to grow in their place useful growths.

The land can only support a certain quantity of herbage, and if the worthless growths preponderate, the useful growths must suffer in that proportion. There is only a certain quantity of plant food immediately available in the soil, and if this is used up by the worthless Plants, the useful Plants become starved, till dwindling in strength they gradually die out.

The chemist has discovered for us this interesting fact, that by the use of certain artificial, and well-made farmyard manures, the soil is supplied with suitable and available Plant-food, which specially nourish the useful growths. This enables the good growths to acquire strength, and to crush out or obtain the victory over the worthless growths.

But if a field is left unmanured and uncared for, and is not grazed by suitable corn and cake-fed stock, then the worthless Plants crush out and gain the victory over the useful Plants.

It would seem as if land when left to itself, reverts back to a kind of primitive wilderness.

The Useful Grasses—How Discovered.

How have the useful grasses been discovered? Like most of the discoveries in Agriculture, by observation. An observant Farmer, as he carefully watched his stock grazing, would notice that they ate certain grasses readily; at the same time he would observe that they left other grasses alone, or only ate them when compelled by scanty fare or hunger.

He remembered the growths that his stock liked, and whenever he saw them growing he would recognize them as being old friends.

Farmers have often said to the writer, as he walked over their fields with them, "I don't

know its name," pointing to a particular growth, "but I know that my cows eat it and do well on it, and that one," pointing to another growth, "is quite useless to me, and I should like to get rid of it out of my fields, because the cattle won't touch it."

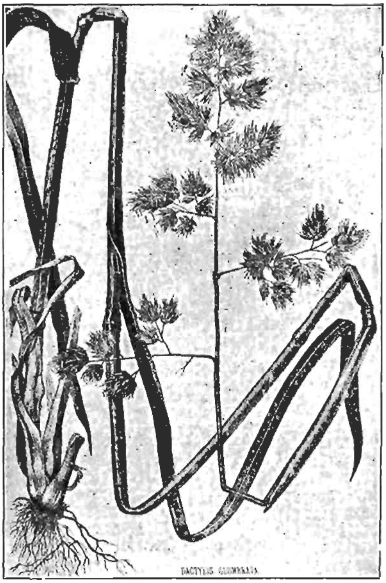
The chemist and the botanist, learning this practical wisdom from the farmer, take the different growths, and analyse them, that is, find out the different parts that compose them, and the amount of nourishment that they contain. And it is found that the outdoor practical wisdom of the farmer, and the indoor knowledge of the chemist, generally agree, and should they differ, the writer would back the natural instinct of the Cow, and the observation of the Farmer.

So the natural wisdom of the Cow, the observation of the Farmer, the analysis of the Chemist, and the trials of the Experimenter, have combined to give us some very exact knowledge, and this knowledge has shown us which are the best feeding growths, the medium feeding growths, and the absolutely worthless feeding growths.

A List of Good Grasses for Feeding.

You will now read something about the valuable Feeding Grasses and Clovers, in their order of flowering, and then you will read

some simple facts about them. You must remember however, that in different parts of the country the grasses differ somewhat in their time of flowering, according to the climate; for instance the grasses and wild flowers in the southern counties flower a fortnight or three weeks earlier, than the same growths in the northern counties.


ROUGH COCK'S-FOOT (*Dactylis Glomerata*).
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Stems 2-3 feet.

(1) Meadow Fox-tail (*Alopecurus Pratensis*) flowers from middle of April to June. Grows in meadows and pastures.

(2) Sweet-scented Vernal (*Anthoxanthum odoratum*) flowers in April and May. Grows in fields, woods, and on banks.

(3) Rough Cock's-foot (*Dactylis Glomerata*) flowers in June and July. Grows in pastures, woods, orchards, and waste places.

(4) Perennial Rye Grass (*Lolium Perenne*)

flowers in May and June. Grows in pastures, on banks and waste places.

(5) Tall Fescue (*Festuca Elatior*) flowers in June and July. Grows in damp pastures and wet places.

(6) Various leaved Fescue (*Festuca Heterophylla*) flowers in June and July. Grows in meadows and pastures.

(7) Meadow Fescue (*Festuca Pratensis*) flowers in June and July. Grows in good pastures.

PERENNIAL RYE GRASS (*Lolium Perenne*).
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Stems 18 inches.

(8) Hard Fescue (*Festuca Duriuscula*) flowers in June and July. Grows in hilly places.

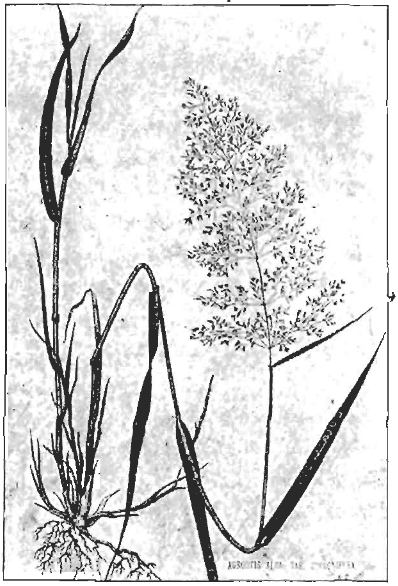
(9) Sheep's Fescue (*Festuca Ovina*) flowers in June and July. Grows in dry, hilly pastures.

(10) Italian Rye Grass (*Lolium Italicum*) flowers in June and July. Grows in pastures and hedgerows.

(11) Smooth-stalked Meadow Grass (*Poa

Pratensis) flowers in June and July. Grows in meadows and pastures.

(12) Rough-stalked Meadow Grass (*Poa Trivialis*) flowers in June and July. Grows in meadows and pastures, and prefers strong moist soil.



FIORIN (*Agrostis Stolonifera*).
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Stems 6-24 inches.

(13) Wood Meadow Grass or Evergreen (*Poa Nemoralis*) flowers in June and July. Grows in woods and shady places.

(14) Yellow Oat Grass (*Avena Flavescens*) flowers in June, July and August. Grows in pastures.

(15) Crested Dog's-tail (*Cynosurus Cristatus*) flowers in June, July, and August. Thrives best in compact dry soil, and above a chalk subsoil.

(16) Fiorin (*Agrostis Alba*) flowers in July and September. Thrives best in moist, poor soils, both sandy and peaty.

(17) Timothy or Meadow Cat's-tail (*Phleum

Pratense) flowers in June and August. Grows in meadows and pastures, and prefers a cool and damp soil.

Clovers.

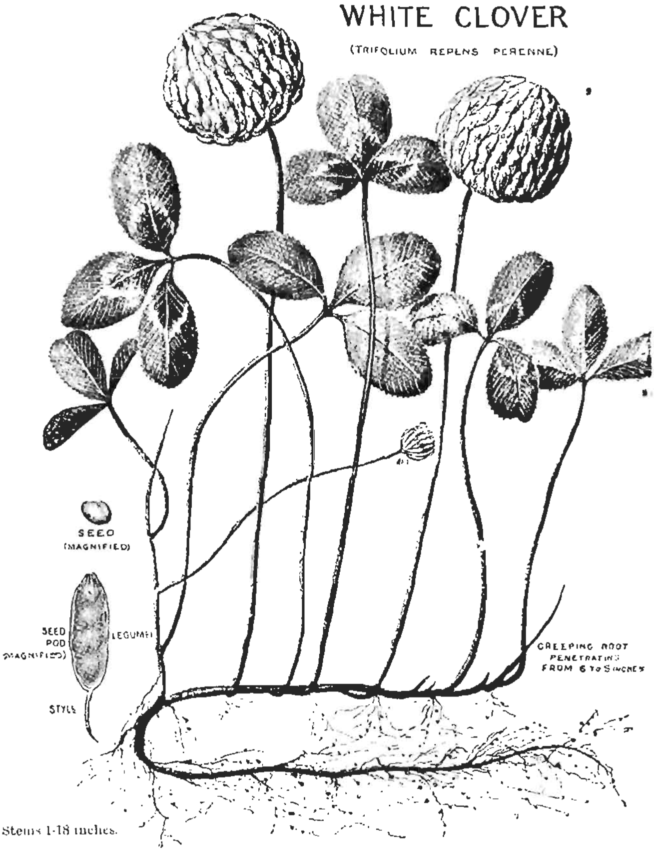
(1) White Clover (*Trifolium Repens Perenne*) flowers from May to October. Grows nearly everywhere, and springs up spontaneously upon rich land containing lime.

(2) Red or broad Clover (*Trifolium Pratense*) flowers in June and September. Found everywhere.

(3) Perennial red Clover or Cowgrass (*Trifolium Pratense Perenne*) flowers in July. Very common.

(4) Alsike Clover (*Trifolium Hybridum*) flowers in July and August. Grows freely on moist soil.

Some of the grasses mentioned contain more water and more indigestible fibre, and less nutritious solids than others. The grasses that the chemist tells us stand first on the list as useful for feeding are "Meadow Fox-tail," "Sheep's Fescue," "Smooth-stalked Meadow Grass," "Rough-stalked Meadow Grass," "Hard Fescue," "Meadow Fescue," and "Various leaved Fescue," then follows the Perennial and Italian Rye Grasses, the Sweet Vernal, and the Cock's-foot.



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The chemist also tells us that the grass that stands the highest on the list, because it contains so much flesh-forming and digestible food, is the "Meadow Foxtail."

The first-named grasses, together with Peren-

nial Rye Grass and the Timothy, are very valuable feeding grasses.

Among the Clovers the Cow-Grass and the Alsike Clover stand out very prominently, but you may take it that all the Clovers are very nourishing, and contain but little indigestible fibre.

We will now read some particulars of the grasses in their order.

MEADOW FOX-TAIL (*Alopecurus Pratensis*).
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Stems 1-3 feet.

(1) **Meadow Fox-tail.** — This grass is rich in flesh-forming properties and digestible fibre, and is one of the most valuable grasses growing, either in permanent pasture or in the hay fields. The Foxtail is one of the earliest grasses to flower, and its growth is quick, its herbage sweet, and it is most eagerly sought after by all stock. It can generally be found in ear by the middle of April. The ear has much the appearance of a round tail ending

in a point, and if drawn from base to tip between the finger and thumb, it feels soft and silky. The colour of the ear is silvery grey.

The leaves are soft, green, succulent, and very numerous; they are long, broad, and strongly veined.

The Foxtail is not only valuable because of its feeding properties, but it is especially valuable because, in the early spring, it throws up nourishing feeding growths before the other grasses have made much of a start.

It resists well the cold of winter, and the late frosts influence it but little; it does well in sunny and shady situations. If you think it advisable to grow grass in your orchard, between your apple trees, there is no grass better suited for the purpose than the Meadow Foxtail, provided your soil is deep and heavy—which it should be if you wish to obtain a handsome and heavy crop of fruit. Owing to the precocious, or early growth of the Meadow Foxtail, its rich green will cover the soil, before the leaves of the fruit trees are out to intercept the sun's rays.

Don't attempt the growth of the Foxtail on thin light soils, or on soils that are not well drained. It does best on rich loams, and will even grow on damp soils and irrigated meadows.

Another great feature of the Foxtail is that it forms what is termed an even Sward. It does

this by short prostrate Stolons, or creeping stems. These creeping stems send down little rootlets into the soil, and send up leaves into the air, with short spaces between them. This manner of growth prevents that tufted appearance which is such an eyesore, and gives to a piece of grass an even face.

SWEET VERNAL (*Anthoxanthum Odoratum*).
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Stems 6-12 inches.

The Meadow Foxtail shares with the Sweet Vernal the distinction of being the earliest to flower of all the useful grasses.

On a good soil the Meadow Foxtail is quite capable of yielding three good growths in the year. During the first year of sowing the yield is only moderate, it is more abundant in the second, and in the third year it reaches its highest development.

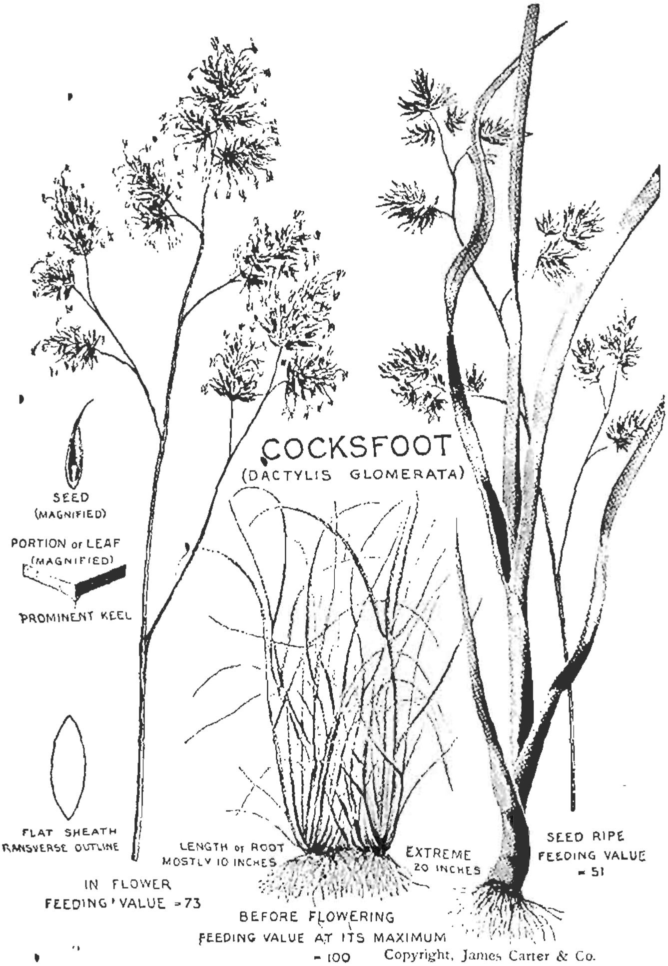
(2) **Sweet Vernal** is an early grass to come into flower, it may be gathered in ear at the

beginning of April, as it throws up leaves almost before the winter is gone. It is of sparse habit and constitutes only a very small proportion of the total herbage of any field. If you chew a stalk of this grass you will at once perceive an odour similar to new mown hay. This beautiful smell increases as the grass dries.

When you pull a handful of freshly made hay out of a well-made stack, it will feel crisp to the touch, and if it has been well made, it will be of a light green shade to the eye, and of a sweet lavender smell to the nose. This smell in a large measure arises from the Sweet Vernal it contains. Therefore Sweet Vernal acts as a kind of condiment, or sweetener, to the coarser and duller smelling grasses of the hay stack.

The leaves of the Sweet Vernal are flat, broad, and somewhat hairy, but the grass is not of a coarse growth. It sends up its leaves in compact tufts, and continues to do so till late in the autumn.

(3) **Cock's-foot** is one of the easiest grasses to recognise. Its spikelets are crowded together into thick clusters, and in appearance it certainly does resemble a cock's foot. It is a large coarse-growing plant, rough and harsh to the touch; it is tall and of quick growth, and its leaves are broad, thick, juicy, and of a bluish green colour.



The Cock's-Foot has a fibrous root, much branched and descending deeply into the ground;

it forms dense cushions or tussocks, and does not cover the ground with an even carpet of green, as the Meadow Foxtail does.

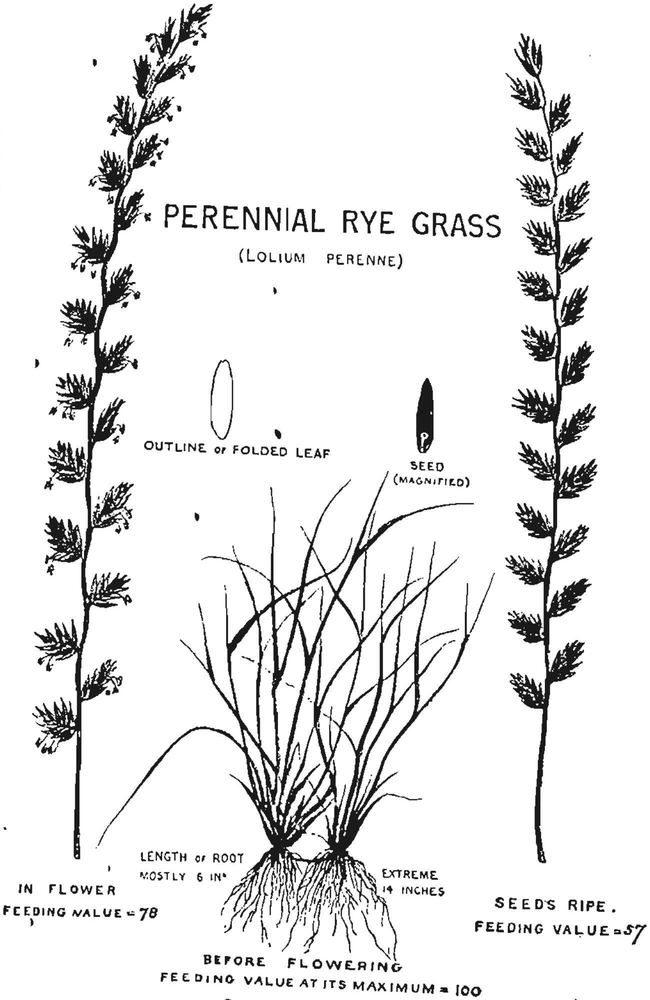
For this reason Cock's-Foot is never sown alone, for its tufted growth would result in the formation of a patchy irregular Sward. It should be cut, if practicable, before flowering, otherwise the stems become hard and woody, and therefore less acceptable to animals as fodder.

After the Cock's-Foot is mown and made into hay, it again grows rapidly, and therefore gives a very abundant Aftermath, or second growth.

Rye Grasses.

You can always distinguish the Perennial from the Italian Rye Grass, because the little florets or flowers of the Italian Rye Grass have little hairs springing from them, or as it is termed, they are "awned," while those of the Perennial Rye Grass are seldom "awned." Also the ears of the Perennial Rye Grass look almost flat, as if they had been passed through a press. The leaves of both grasses are of a very glossy dark green, and glisten conspicuously in the sunlight. If you take up a leaf you will find a well-marked line or mid-rib extending along its back.

This bright glistening green leaf is common to both Rye Grass and Meadow Fescue, but the Rye Grass has a well-marked central line running



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down the leaf, which is absent in the leaf of the Meadow Fescue.

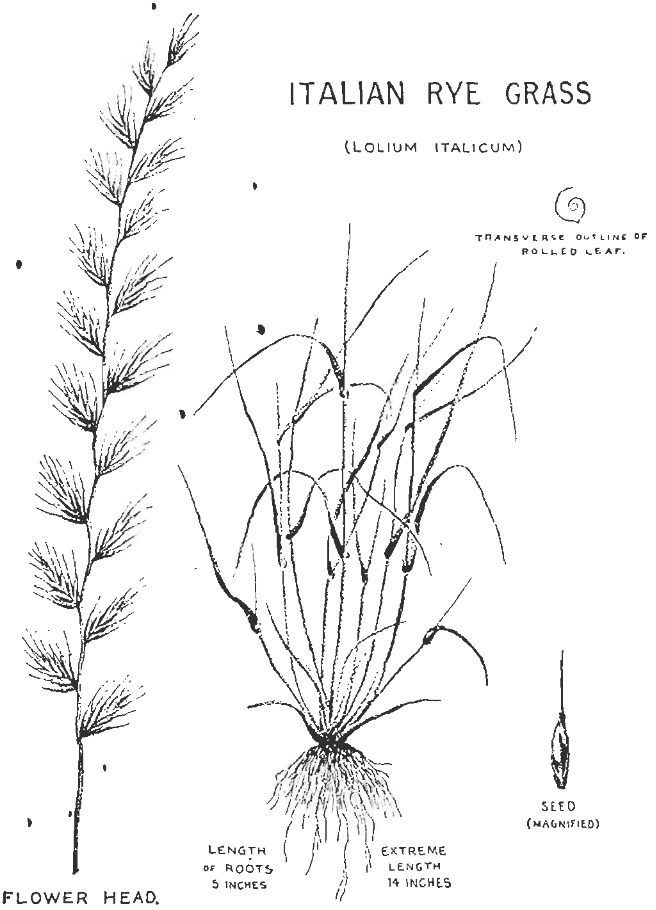
It is an interesting fact to note that some grasses will thrive best under the treading of animals, and this is true of the Perennial Rye Grass, and therefore we find that it grows in abundance in well-grazed Pastures.

Perennial Rye Grass requires a rich soil to grow in, and in such localities this grass will be found largely cultivated.

As you walk along the lanes you must constantly have noticed the abundance of three growths: Cock's-Foot, Rye Grass, and White Clover, the reason for this probably being that the washings, scrapings, and droppings from the road find their way over the wayside and so manure the soil in which these plants grow, and this causes the dormant seeds of these three growths to spring up with great vigour. The richest herbage is often found growing in great luxuriance along our roads and lanes, but sad to say, it is often made no use of. The herbage along our roads and lanes would help to graze many a cow, and the cut grass would provide acceptable green food for pigs and poultry during the spring and summer months.

The Italian Rye Grass is a larger and stronger plant than the Perennial Rye Grass, and it throws up an earlier cutting or earlier bite in the

spring,—a very important consideration for all farmers. It is sown with Clover for the purpose of making Seed Hay, and we possess



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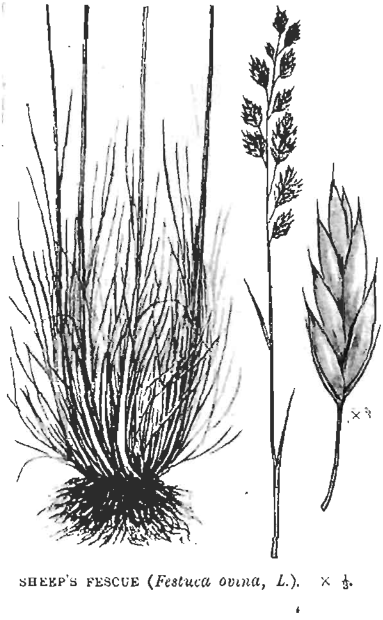
no more valuable plant for this purpose, because it is very nutritious, grows very fast, and yields a heavy crop of herbage.

Dairy cows when grazed upon a temporary ley of Italian Rye Grass give an abundant flow of milk; and the flavour of the butter or cheese made from this milk is excellent. The Italian Rye Grass is never found in old pastures.



SHEEP'S FESCUE (*Festuca ovina, L.*). × ⅓.

Fescues.

The Fescues are an important group of grasses, some of them having a high feeding value. They may be divided into the broad-leaved Fescues, and the narrow-leaved Fescues. The broad-leaved growths include the Meadow Fescue, Tall Fescue, and Spiked Fescue.

The narrow-leaved growths include the Sheep's Fescue, Hard Fescue, Red Fescue, and Various-Leaved Fescue, and Fine-Leaved Fescue.

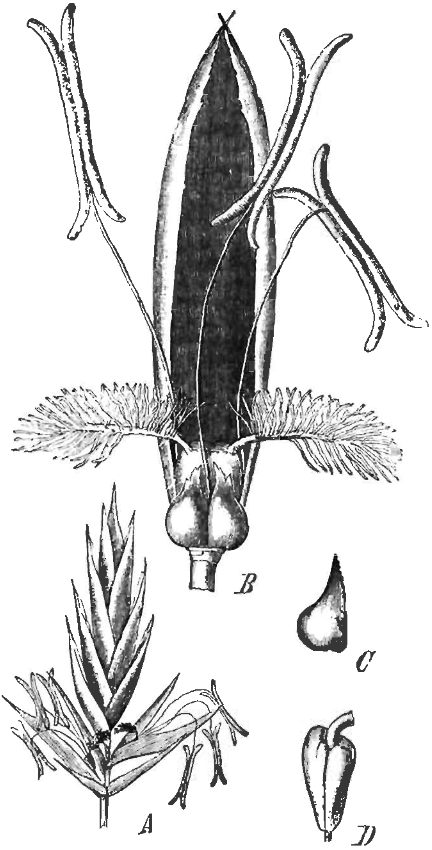
The broad-leaved Fescues are really slight modifications of the Meadow Fescue.

The Meadow Fescue is a valuable grass for hay and grazing fields. It is a deep-rooted plant, and thrives best on damp clay soil, and therefore will not stand too much dry weather. It grows in compact tufts, and under suitable conditions its stems, furnished with long broad leaves, rise to a height of two or three feet.

MEADOW FESCUE (*Festuca Pratensis*).
Copyright, S. & S.
Stems 2-6 feet.

Tall Fescue is found on the borders of water-courses, and is a magnificent grass growing to a height of some six feet.

Spiked Fescue is a more slender plant than the Meadow Fescue, and owing to the spikelets of its ears being without stalks, it is in external appearance very similar to the Perennial Rye Grass. It can, however, be distinguished from the Perennial Rye Grass on account of its spikelets



Festuca Pratensis.

A, Spikelet with two open flowers, below which the two sterile glumes are seen (×3); *B*, Flower; the two lodicules are in front, the palea superior behind; the ovary bears two feathery stigmas (×12); *C*, a single lodicule (×12); *D*, ovary seen from the side with the stalk of one of the removed stigmas (×12).

(Strasburger.)

having a less flattened appearance. The spikelets of the Perennial Rye Grass look as if they had been flattened out by a press.

The Narrow-Leaved Fescues are generally to be found on dry, chalky, or gravelly soil; they form as a rule a compact bottom to the turf, and for that reason are most suitable for sheep pastures.

Sheep's Fescue may be taken as the type of the narrow-leaved Fescues; it forms a thick tufted herbage, of

very fine wiry-looking leaves. It is a common grass on limestone pastures, and on chalk downs which are grazed by sheep, where it helps to form a close carpet of green, wiry, but nourishing herbage. The variations of the Sheep's Fescue (as we have stated), are the Hard Fescues, Red Fescue, Various-Leaved Fescue, and Fine-Leaved Fescue.

SMOOTH-STALKED MEADOW GRASS (*Poa Pratensis*).
Copyright, S. & S.
Stems 1-2 feet.

Meadow Grasses.

You can distinguish the Meadow Grasses by the graceful, tree-like branching of their panicles. In appearance they are somewhat like the Fescues. There are three varieties that are useful to the agriculturist—the Smooth-Stalked Meadow Grass, the Rough-Stalked Meadow Grass, and the Annual Meadow Grass.

Smooth-Stalked Meadow Grass thrives best upon dry soils of good quality. It is rather a surface-rooted than a deep-rooted plant, and is

of creeping habits, and withstands drought. It is a grass of early growth, and is therefore valuable for dry pastures.

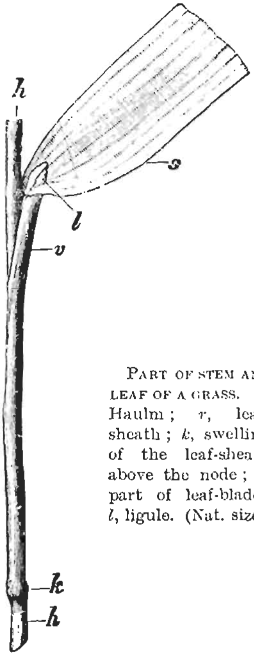
Rough-stalked Meadow Grass grows best on strong, moist soils, and gives to the herbage a deep, rich colour. It is less hardy than the Smooth-Stalked Meadow Grass, and prefers shady situations, so that in pastures and meadows where it grows, it may generally be found in abundance beneath trees. You may often see this grass springing up in the rich soil of your gardens, especially among your bush fruit-trees. Annual Meadow Grass is less common than the two preceding species.

ROUGH-STALKED MEADOW GRASS (*Poa Trivialis*).
Copyright, S. & S.
Stems 1-2 feet.

Oat Grasses.

These belong to the same family as the cultivated Oat, but being uncultivated they are

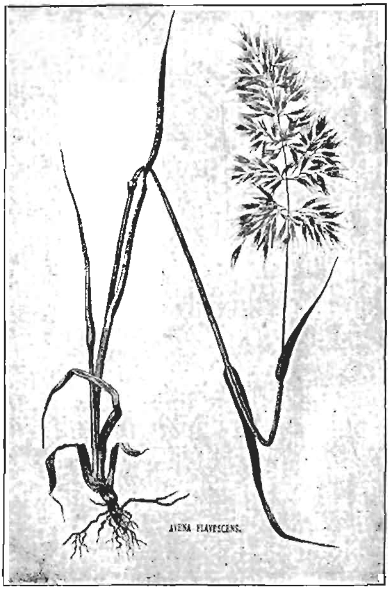
inferior in size. There are only two of these wild oat grasses which are of agricultural value—the Yellow Oat Grass and the Tall Oat Grass; while the Downy Oat Grass, the Narrow-Leaved Oat Grass, and the Wild Oat Grass, having no feeding value, we look upon as weeds.



Part of stem and leaf of a grass. *h*, Haulm; *v*, leaf-sheath; *k*, swelling of the leaf-sheath above the node; *s*, part of leaf-blade; *l*, ligule. (Nat. size.)

Yellow Oat Grass, or golden oat grass, is one of the most graceful of the British grasses. The panicle is of a shining yellow colour, and glitters in the sun. Up to the time of flowering the ear is very compact, and is beautifully shaded with green and gold; whilst its delicate silky "awns" look like streaks of silver. As the flower develops, the entire panicle spreads out into a tree-like form, and then it is one of the most beautiful sights in the midsummer meadows. When the blooming time is over, and the seeds begin to ripen, its lovely colours disappear, and it becomes brown and withered.

If the grasses in their three stages—before flowering, during flowering, and after flowering—are placed side by side, it is very difficult to believe that they belong to the same plant. The Yellow Oat Grass is a valuable grass both for forage and for hay.



YELLOW OAT-GRASS (*Avena Flavescens*).
Copyright, S. & S.
Stems 1-2 feet.

Tall Oat Grass, or False Oat Grass, may often be found in or near the hedgerows on the borders of grass fields. Some authorities state that this grass has no feeding properties, but the opinion on the whole, now seems to be, that if it is mixed with other herbage it has some value. It thrives best on medium soils and clay loams, and attains a height of three to four feet. It is in ear from early summer into late autumn, and has a pale, purplish, shiny appearance. The whole plant has a bitter flavour, but when consumed in

conjunction with other grasses, this bitter flavour may add to the varieties of flavours, so necessary for the well-being of stock.

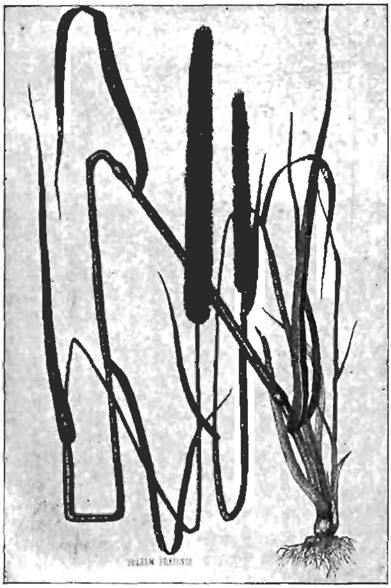
Crested Dog's-tail is essentially a grass of the pasture, and not of the hay field. It helps to form a good and solid bottom to the pastures, and in conjunction with Narrow-Leaved Fescue makes a suitable Sheep Pasture. If the turf has not been closely grazed in spring and early summer, the withered culms of this grass may be seen standing at the fall of the year.

CRESTED DOG'S-TAIL (*Cynosurus Cristatus*).
Copyright, S. & S.

Fiorin, or Creeping Bent Grass, is a stout-leaved grass, which sends out prostrate stems, creeping amongst the other herbage, and rooting itself wherever it gets a chance. In consequence it spreads with great rapidity. Fiorin thrives in moist, poor soils. It can hardly be said to be a favourite with

stock, but it affords a good bite late in the autumn. It is very popular in Ireland.

Timothy or Meadow Cat's-Tail grass might be mistaken for the Meadow Fox-Tail, because there is a certain resemblance between the ears, but they are really very different. The ear of the Timothy is green and rough to the touch, whereas the ear of the Fox-Tail is silvery grey, and smooth to the touch. Timothy, moreover, is one of our latest grasses to flower, while the Fox-Tail is one of the earliest.



TIMOTHY OR MEADOW CAT'S TAIL (*Phleum Pratense*).
Copyright, S. & S.
Stems 6-18 inches.

The leaves of the Timothy are a greyish, green colour, and they are broader, and especially when dried, are stiffer or more rigid than those of the Fox-Tail—hence there is no difficulty in distinguishing the leaves of the Timothy from the leaves of the Fox-Tail, in a sample of hay.

The Timothy Grass will grow on damp soil, and at the same time will resist drought. Another important point in favour of the Timothy is; that it will resist frosts which would kill many other varieties of grasses.

When grown by itself, Timothy produces somewhat irregular Swards of moderately close tufts. When it is associated with other grasses or clovers it gives an abundant produce, for its hay is heavier than that of any of the other cultivated grasses.

It should be mown before flowering, otherwise its fibre becomes woody and the hay heavy and hard.

All farm stock eat the Timothy with relish.

The Clover Family.

The members of the genuine clover family are called Trifolium, because their leaves are made up of three leaflets. If you notice a clover field at night, you will see that all their leaves close up at sunset, so that the plants may retain some of the warmth that they have taken in during the day. Darwin named this the sleep of plants. Their little pea-like flowers, similar to the garden pea, are all collected together into dense heads.

The clovers usually found in cultivation are the White or Dutch Clover, the Broad-leafed Clover, the Cow-grass, the Alsike Clover, and the Trifolium.

The *White* or *Dutch Clover* spreads itself by creeping stems or stolens. It is a most valuable feed in all pastures, where it helps to form a rich turf of close-bottom herbage.

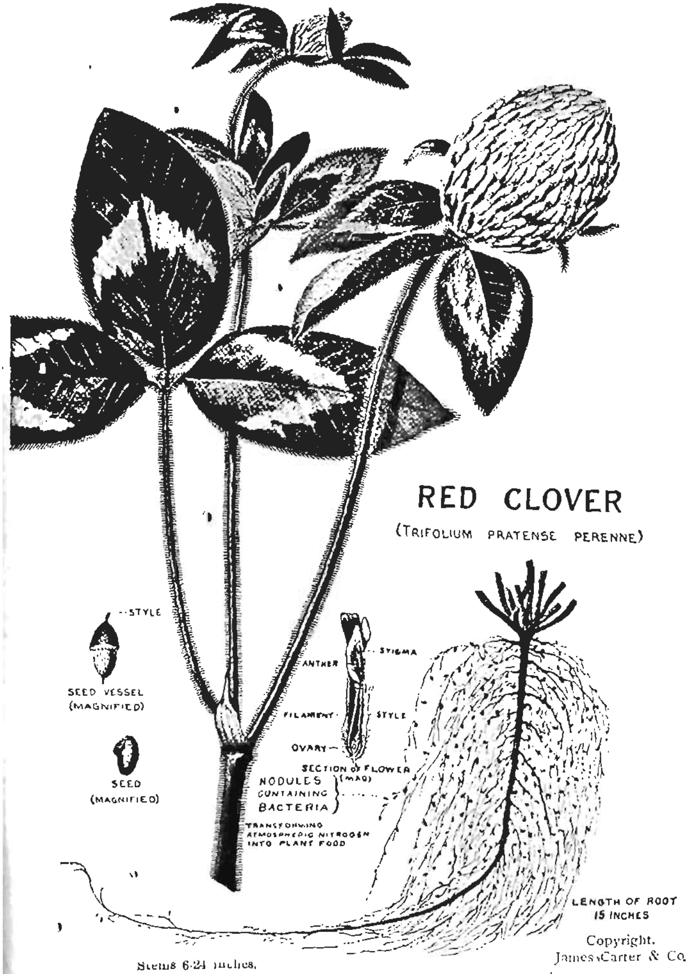
It is a most remarkable fact, which the writer is unable to account for, that wherever certain artificial phosphate manures are placed, White Clover will shortly appear, although there has been no previous sign of it. An artificial manure, called "Basic Slag," if applied to the heavier lands, which are suitable for its application, will bring up the White Clover as if the seeds had been sown with the manure.

Red or Broad-leafed Clover is also known as purple or meadow clover. It has a fine head of purple flowers, and is a very robust plant.

Red-leafed clover is commonly grown as a hay crop, but it is also folded with sheep. On good soils it will stand two or three years. It is this clover that is especially liable to a sickness called clover sickness, and when this disease impregnates the land, the Red Clover ought not to be sown again for ten or twelve years, in order to allow the land to clear itself of infection.

Clover sickness is caused by minute Eel-like Worms that live in the stems of the plants. A healthy crop of Red Clover generally affords a most abundant yield.

Cow-grass is a variety of red clover which



arrives at maturity later in the year than Red Clover, and being less liable to clover sickness,

and of a more lasting character, is used for mixing with seeds that are intended to remain down for some time without being ploughed under. Cow-grass being cut late, yields only one cut, and therefore is called a single-cut clover. The Red or Broad-leafed clover being an earlier plant, can be cut twice in the season, and therefore is called a double-cut clover.

You can distinguish the Red Clover from the genuine Cow-grass by this. In Red Clover of whatever variety, the stipules are broad, whitish structures, with a network of coloured veins standing out on the white ground. In genuine cow-grass, the stipules are long and narrow, and as green as the blade of the leaf.

Alsike Clover can always be distinguished wherever you see it in flower, because the little centre florets are white, and are surrounded by a circumference of little pink florets. Its whole appearance gives you the impression of being, what it really is, an intermediate growth between the Red Clover and the White Clover. The stems of the plants are hollow and smooth. It grows freely on moist soil, and is very little susceptible to clover sickness, therefore when the land is impregnated with the minute eel-like worms, that attack the Red Clover when planted and so cause it to become sick, the Alsike Clover can be grown in its place.

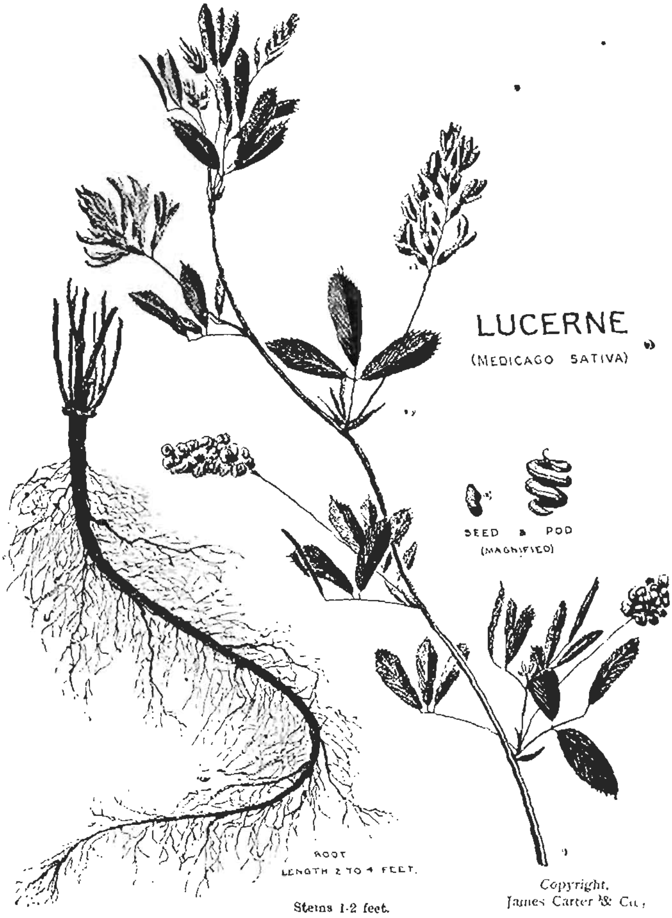
Crimson Clover is the clover which the farmer calls Trifolium. It has a lengthened velvety head of dark crimson flowers. It is a single cut clover, and is commonly grown as a catch crop.

The other cultivated plants of the pea family (leguminous plants) not strictly clovers, are the "Lucerne," the "Sainfoin," and the "Vetches."

The *Lucerne* where it will grow is a most useful plant, not only for feeding stock, but because its roots, by penetrating deeply into the soil, break up the sub-soil and thus give the roots of the surface-feeding plants a larger area in which to find their food. It is said that in order to thrive, it must find a soil of a chalky nature, but the writer has known it do well on heavy clay lands, where there was apparently no chalk to be found. In some of the states of America it is grown under every condition of soil and climate, and grown with success, wherever its deep, penetrating roots can reach moisture.

It is a plant that will withstand drought, and if its roots can find moisture, it unquestionably does well on the chalky and lighter soils of this country. It will keep down as a healthy plant, in some cases for ten and twelve years, and give three or four good green cuts a year. Horses are particularly fond of it. It does not make a satisfactory hay. It is such a valuable

crop that every farmer, as an experiment, will



do well to grow a small plot of Lucerne, to see whether it will thrive on his farm.

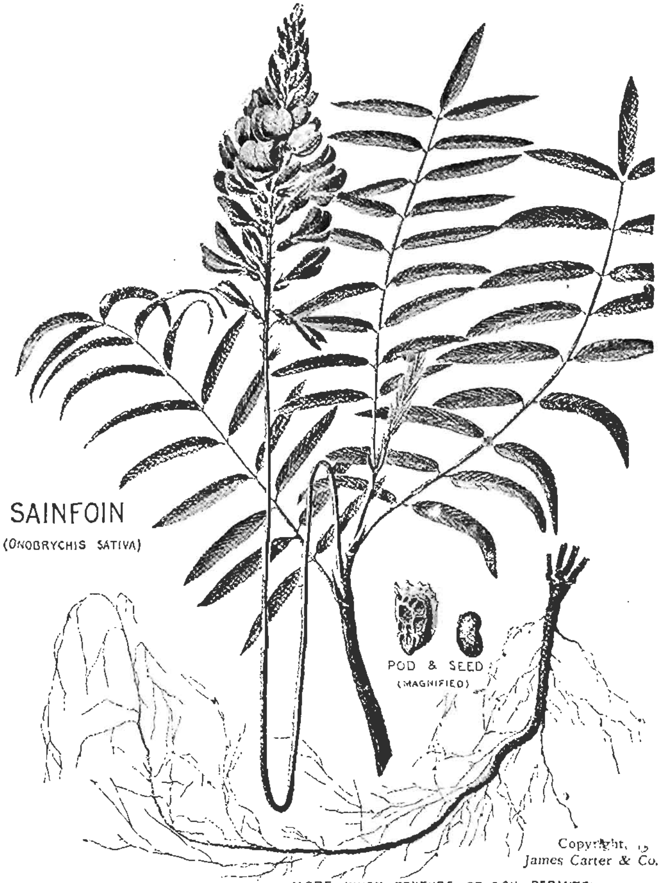
It is best sown in the spring, and ought to be sown in rows with sufficient space between them to enable a man to hoe up the weeds, which if allowed to grow unchecked would soon smother the young plants.

The Lucerne differs from the true clover, in that the flowers are arranged in compact Racemes. By a Racemes is meant a number of short-stalked florets springing from a common axis, so that the result is not unlike a clover head. The Lucerne is a tall and robust plant, with loose Racemes of purplish-blue flowers.

Sainfoin. There are few more beautiful sights in this country, than a field of Sainfoin in full bloom. It can be seen most frequently in chalk districts. It is a robust plant, with stout woody root, and has long handsome leaves of twelve to twenty leaflets, and bold Racemes of large pink flowers. Sainfoin is allowed to remain down from three to seven years, and is either grazed by stock or mown for hay.

The *Vetches*, or *Tares*, are a highly nutritious food, and are relished by all kinds of stock. The stems are trailing, and the pale purple flowers grow one or two together, without stalks, from the leaf axils. The end of the leaflets are converted into tendrils which enable the plant to keep itself off the ground by any support it may

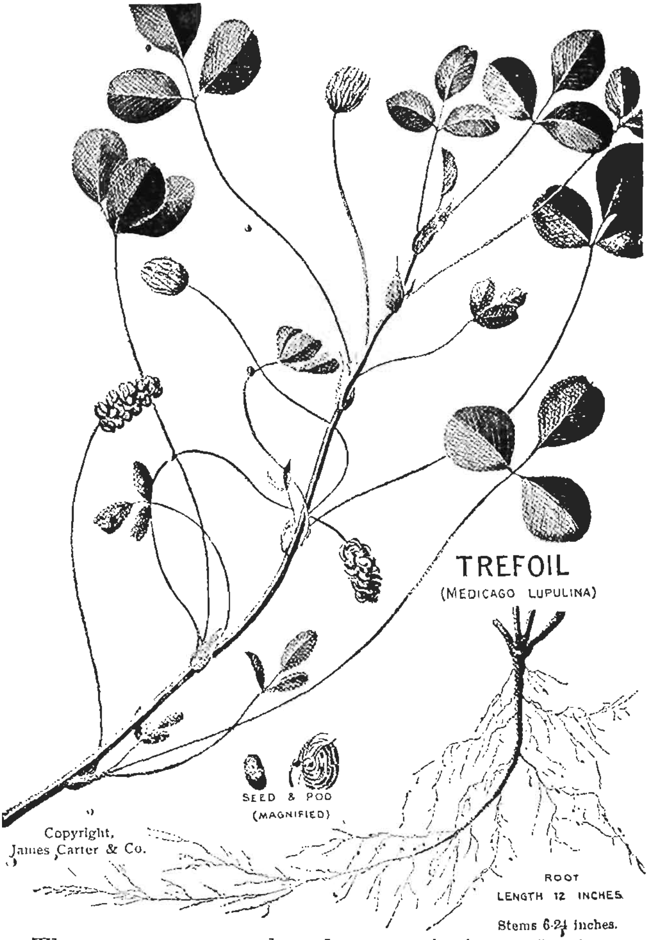
find. A little Rye or Oats are sometimes sown with the vetches because the upright stems of



ROOT LENGTH FROM 1 TO 7 FEET OR MORE WHEN TEXTURE OF SOIL PERMITS
Stems 1-2 feet.

these plants afford a support for the tendrils of

the vetch plants to cling to, which enables the whole plant to grow erect.



There are several other varieties of clover

which are not cultivated, but can readily be found growing wild in most parts of the country.

Yellow Suckling Clover is a yellow flowering plant with slender flower stalks, and somewhat smaller than the cultivated clover.

HAIRY WOOD BROME GRASS (*Bromus Asper*). Stems 2-6 feet.

Hop trefoil has a head of minute pea flowers, which gives it the appearance of a small yellow hop cone.

Zig-zag trefoil has a head of rose purple flowers and a straggling zig-zag stem, which takes possession of the soil with great rapidity.

The other members of the pea family commonly found growing wild are the Bird's-Foot Trefoil, the Kidney Vetch, Yellow Melelot, Furze, Gorse or Whin, Broom, Rest-Harrow and Meadow Vetchling.

Useless Grasses for Feeding

are those grasses of the grazing and hay fields that when eaten, are harmful to the live

stock of the farm; or grasses which the live stock will not eat with relish, or from which owing to their woolly and indigestible nature, stock can extract but little nourishment.

As you have read, if a piece of grass land contains a great number of these useless grasses, it must also contain a smaller number of the useful grasses.

UPRIGHT PERENNIAL BROME-GRASS
(*Bromus Erectus*).
Stems 1-3 feet.

The feeding area of the soil, the surface, only consists of a certain area of space, a certain amount of moisture, and a certain quantity of available plant food.

If this limited space is occupied by useless grasses, they absorb the moisture and plant food, and so starve or crowd out the useful growths.

The useful grasses can be encouraged at the expense of the useless grasses, by skilful manuring and management, and by careful grazing with suitable corn and cake fed stock. If this is done a farm will support a larger number of stock to the acre,

than would be the case if by unskilful farming the useless grasses gained the upper hand.

The writer has taken the greatest pains to put before you the best illustrations he can procure of the useful and useless grasses. In looking at the pictures your eyes will get slowly accustomed to their different appearances, so that when you walk over the fields or along the lanes, you will be able to recognise them again. But it is even more important that as you walk along, you should pick the different growths, and compare them with the illustrations, and with the short descriptions given of them.

COMMON REED (*Arundo Phragmites*).

If you take the trouble to do this as you walk through a field, you will be able to see for yourself of what value the field is for feeding stock, or for turning into hay. Also when you gather a handful of hay, picked up either in the hay field or drawn out of the hay stack,

you will be able to separate and name the different grasses, and state whether you are holding in your hand a good or bad feeding sample of hay.

Names (v. Description).

Common Bent (*Agrostis Vulgaris*).
Marsh (*Agrostis Alba*).
Slender foxtail (*Alopecurus Agrestis*).
Downy oat grass (*Avena Pubescens*).
Narrow-leaved oat grass (*Avena Pratensis*).
Wild oat grass (*Avena Fatua*).
Brome grasses (*Bromus Mollis*).
Couch ,, (*Triticum Repens*).
Hair ,, (*Aira*).
Meadow barley grass (*Hordeum Pratense*).
Quaking grass (*Briza Media*).
Yorkshire fog (*Holcus Lanatus*).
Darnel (*Lolium Temulentum*).
Annual meadow grass (*Poa Annua*).

Common Bent and **Marsh Bent** are two weed grasses, commonly termed Twitch or Couch. These grasses find a suitable home in poor meadows, and in some descriptions of arable land.

Slender Foxtail. Although this grass is said to be related to one of the most useful grasses that can be grown on the farm, namely the Meadow Foxtail, it is one of the worst pests of the farm. In appearance it is something like the

valuable Foxtail, but it is less robust, its ear is more slender, and it is blotched with black, therefore it is sometimes called the Black Bent. It bears another name which most accurately describes it, the "hunger weed."

SLENDER FOX-TAIL GRASS
(*Alopecurus Agrestes*).
Stems 1-2 feet.

It is not often found in pastures, but principally in arable fields, and where it takes hold of the land, it is known to destroy whole fields of wheat. It may be found in ear in May and June, and if it is not destroyed before it sheds its seed, foul land, or the land full of weeds, may be expected the following year.

Weed Oat Grasses, include the Downy Oat Grass, the Narrow-Leaved Oat Grass, the Wild Oat Grass or Havers.

The **Downy Oat Grass** can be recognised by its dense covering of close-set hair, which gives to the plant a somewhat woolly appearance. It is found in dry pastures and in chalky districts.

The **Narrow-leaved Oat Grass** has larger spikelets than the Downy Oat Grass, but its lower leaves, though harsh and rough, are not hairy.

The **Wild Oat Grass** very much resembles the cultivated oat, and is a weed of the corn fields.

DOWNY OAT GRASS
(*Avena Pubescens*).

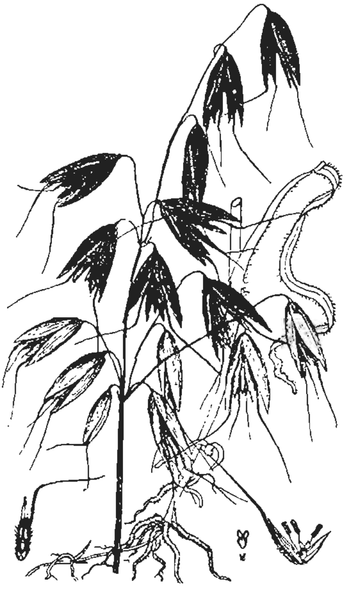
NARROW-LEAVED OAT-GRASS
(*Avena Pratensis*).
Stems ½ to 3 feet.

It is an annual plant, that is it grows from seed each year, and dies down on the approach of winter.

Darnel. Although related closely to the useful Rye Grasses, it is looked upon as a weed of the

corn field. The seeds of this plant are poisonous, and when eaten by poultry cause a kind of intoxication.

Brome Grasses. There are many varieties of the Brome grasses, and very beautiful grasses



WILD OAT OR HAVER
(*Avena Fatua*).
Stems 1-3 feet.

SOFT BROME GRASS
(*Bromus Mollis*).
Stems 4-24 inches.

they are, but for all that they are weeds. The Soft Brome grass and the Barren Brome grass are the most common of the group. The soft Brome Grass is found in greater quantities than is desirable in meadows, hay fields,

and temporary leys. Unfortunately it sheds its seed in June, before the hay crop is usually cut, consequently it retains its hold of the land.

BARREN BROME GRASS
(*Bromus Sterilis.*)
Stems 1-2 feet.

Barren Brome Grass (*Bromus sterilis*) is a beautiful and graceful growth, it is found chiefly by the roadside, in fences and hedgerows.

The other members of the group that are common, are the Smooth Brome grass, the Red Brome grass, and the Upright Bromegrass. The Hairy bromegrass is the tallest of the bromes, often towering above the tops of the hedges.

Couch Grass is the most terrible pest that infests our arable land. It is seldom found in pastures. It is called Couch, because its underground stems branch and rebranch in all directions, thus forming beneath the soil a couch or

bed. You can understand that if your land has a quantity of this growth spreading its underground stems in all directions, it would exhaust a great deal of moisture, and use up a great amount of plant food, and so your crop would in consequence lose in yield and in quality of grain.

COUCH GRASS (*Triticum Repens*). Stems 1-4 feet.

When this growth has got well established in the land, it requires a great deal of labour and expense to get rid of it, for the following reason.

If you merely cut up and leave in the land one little fragment of these underground stems, it will commence to grow as an independent plant, and will soon spread with great rapidity.

Couch grass in ear may often be found in the hedgerows of arable fields, where it serves to spread a disease that attacks the straw crops, called Rust. Therefore you can see the importance, if your straw crops are to escape disease, of keeping your hedgerows and headlands free

from this growth, in fact free from the growth of every weed that tends to spread disease, or serves as a protection to injurious insects, or spreads itself over the fields by seeds.

The Bearded Wheat Grass is a relation of the well-known Couch Grass, but fortunately this plant does not exhaust the soil by creeping under-ground stems, and its early leaves are eaten by all kinds of stock.

Annual Meadow Grass is a grass which springs up on bare spots in Pastures and on gravel walks, between paving stones and on walls and roofs. Its small size and the brief duration of its life render it of small value.

Hair Grasses. These grasses make up a pretty group of plants, but unfortunately as they serve no useful purpose, either for the pasture or for the hay field, we must regard them all as weeds.

There are half a dozen different varieties, though as a rule, only one is met with on the farm—the Tufted Hair Grass or Tussock Grass. This grass grows chiefly in wet meadows and pastures, and forms dark unsightly tufts or tussocks. Cattle seldom touch the hard and rough flat leaves.

Up to the time of flowering the whole ear has purplish spikelets of a brilliant silvery lustre. But when the flowering takes place this beautiful appearance goes off.

Meadow Barley Grass is in appearance like a small plant of our cultitivated barley. Its rough nature is unpleasant, and may prove injurious to grazing animals. Sometimes you may see

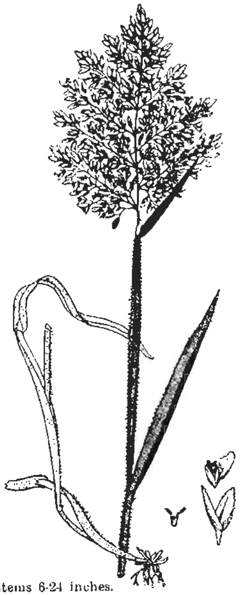
MEADOW BARLEY
(*Hordeum Pratense*).
Stems 1-2 feet.

COMMON QUAKING-GRASS
(*Briza Media*).
Stems 6-18 inches.

growing on the roadsides, especially if the soil is gravelly, a near relation of the cultivated Barley, called Wall Barley or Way Bent.

Quaking Grass. You must all have seen this beautiful growth, with its purplish, nodding, boat-shaped spikelets on their slender stalks, which wave about at every breath of wind.

Yorkshire Fog is a widely-distributed weed grass, unfortunately seen growing too frequently in our grass land. Next to the Couch and the Black Bent or Twitch it is probably the worst weed that we possess. The whole plant has a soft, woolly appearance both to the eye and to the touch. It has a bitter flavour which makes it very distasteful to stock. Its growth does not cover the ground, but its woolly stems grow upright, so that you can see between them spaces of bare ground.


Stems 6-24 inches.
YORKSHIRE FOG.
(*Holcus Lanatus.*)

Like many grass growths the Yorkshire fog is a pretty object before flowering, ranging in colour from green to a purplish shade. But as the seeds ripen it assumes a brown and withered appearance.

Taking weeds generally, those most frequently found in Pastures, are Buttercups, Plantains, Docks, and the narrow-leaved mouse-eared Chickweed.

If you take one pasture with another, Rye grass is the most abundant grass plant, and white clover the most plentiful clover plant.

Plants Found Growing in an Old Pasture.

Grasses.

Marsh Bent Grass.
Fiorin.
Fine Bent Grass.
Meadow Foxtail.
Vernal Grass.
False Oat Grass.
Yorkshire Fog.
Timothy.
Smooth-stalked Meadow Grass.
Rough-stalked Meadow Grass.
Meadow Barley Grass.
Bearded Wheat Grass
Yellow Oat Grass.
Soft Brome Grass.
Dog's-tail.
Rough Cock's-foot.
Spiked Fescue.
Meadow Fescue.
Rye Grass.
Annual Meadow Grass.
Sheep's Fescue.

Clover Family.

Meadow Vetchling.
Meadow or Purple Clover.
Yellow Suckling Clover.
White or Dutch Clover.
Bird's-foot Trefoil.
Creeping Vetch.

Other Growths, Mostly Weeds.

Yarrow.
Daisy.
Earth-nut.
Mouse-ear Chickweed.
Autumnal Hawkbit.
Rough Hawkbit.
Field Woodrush.
Plantain.
Yellow Rattle.
Common Sorrel.
Dandelion.
Cuckoo Flower.
Thistle.
Sedge.
Silver Weed.
Selfheal.
Upright Buttercup.
Bulbous ,,
Creeping ,,
Dock.
Sow Thistle.
Germander Speedwell.

General Remarks.

From what you have read, you will understand that all grass growths that keep stock in health and in strength, and which the stock can convert into the best quality of meat, and the most abundant flow of milk, are regarded as good and useful grasses.

And all those growths that stock will not eat, or if they do eat them, they do them no good, or growths that occupy spaces of ground which the cultivated crops ought to occupy, we regard as useless.

The greater the proportion of the useful growths to the useless growths, the greater the number of horses, cattle, and sheep will your farm support, and the more full will be your stackyard of clean sound grain. In other words, if your farming is to pay, you must keep your land clear of useless growths. Clean pasture, clean seedbed, and sweet herbage, mean careful and wise farming; while foul land, foul seedbed, and rank herbage, mean ignorant and unskilful farming.

In the present day of keen competition, no point must be disregarded; there is nothing too trivial or too small to be beneath your notice.

In conclusion, one last piece of advice to which

the writer would earnestly call your attention. In clearing your land of weeds, do not throw them into heaps, although by mixing the heaps with lime, you may think that you have killed the seeds, and the eggs and larvæ of injurious insects. The life of the seed has been proved to be of very long duration, although for years it may have shown no sign of life. Conditions as yet may not have been favourable for the tiny imprisoned life of the seed to burst out of its protective covering. Then something happens. A little more or less moisture, a little more or less sunshine, a little more or less frost and snow, or the animals may be put to graze the land on an altered system of grazing ; or the manure from yard and bag may be made and applied to the land in a wiser method ; or it may be that the plough is set to work.

Then one or other, or several combined of these changing conditions, may give the signal for the minute life within the tiny seed to awake from its long sleep, and to grow, and to multiply with exceeding vigour, till the whole land is covered with a spreading carpet of weeds.

Great and solemn is the mystery of Life, that lies in us, and everywhere around us, but nowhere is it more mysterious than in the existing life of the tiny seed.

Therefore, when you throw your compost heap

and the sweepings of your stackyard on to your grass land, you may be sowing a crop of weeds, which may cost you or your successors much anxious thought, and many a hard day's work, and many a pound spent in money.

There is only one way to make sure of killing the life of the seed, and the life in the egg of the insect, and the life resting in the chrysalis, and that way is to burn it with fire.

VOCABULARY.

Accumulation (ac-cū-mu-lā′tion): a great collection; mass; heap.

accuracy (ăc′cu-ra-cy): right; truthfulness.

acrid poison: sharp, pungent poison.

addicted (ad-dĭct′ed): given up to.

adheres (ad-hēres′): sticking closely to; clinging to.

agility (a-gĭl′i-ty): quickness of motion; activity.

ambush (ăm′bush): a lying in wait; to lie in wait for.

amphibia (am-phĭb′iá): animal life capable of living on land and in water.

ancestral tree (an-cĕs′tral): the line of descent.

antipathy (an-tĭp′a-thy): natural aversion; repugnance.

appalling (ap-pall′ing): adapted to terrify.

aquatic (a-quăt′ic): living in water.

aquatic plants: plants which grow in water.

aquarium (a-quā′ri-um): an artificial pond for aquatic plants or in which fish are kept and preserved.

arid regions: dry, parched places.

assimilated (as-sĭm′i-lāted′): taken in to become part of a like substance.

attendant (at-tĕnd′ant): that which accompanies.

authorities (au-thŏr′i-ties): those having knowledge of a subject.

bacteria: minute living organisms.

bewildering (be-wĭl′der-ing): puzzling; perplexing.

bray (brāy): the loud, harsh cry of the ass.

cartilage (cär′ti-lage): a tough, elastic animal substance; gristle.

catastrophe (ca-tăs′tro-phe): disaster; a final event; an unfortunate conclusion.

coaxing (cōax-ing): the act of enticing or persuading.

caustic taste: a burning, corroding taste.

cavity (căv′i-ty): a hollow place.

characteristic (char-ac-ter-ĭs′tic): that which is peculiar to.

coincidence (co-ĭn′ci-dence): the act of agreeing in thought, feeling, or purpose.

community (com-mū′ni-ty): people in general; a number of persons, animals, or objects achieving in unison a common end.

compensate (com-pĕn′sāte): to make good; to recompense.

comprehension (com-pre-hĕn′sion): understanding.

concentrated (con-cĕn′trāted′): to bring to a closer union; to bring into smaller compass.

condiment (cŏn′di-ment): a seasoning.

conical (cŏn′ic-al): having the form of a cone.

contract (con-trăct′): an agreement.

controversy (cŏn′tro-ver-sy): dispute; unsettled.

crafty (craft′y): cunning; artful; sly.

cylindrical (cy-lĭn′dric-al): roller-like in form; having the form of a cylinder.

degenerated (de-gĕn′er-ated′): become worse; declined in good qualities.

detection (de-tĕc′tion): discovery of anything hidden.

deteriorated (de-tē′ri-o-rāted): to have become worse.

devastation (dev-as-tā′tion): a laying waste.

deviation (de-vi-ā′tion): a turning aside from the way; a departure from rule.

dispense (dis-pĕnse′): to do without.

dissection (dis-sĕc′tion): the act of dividing a body or object into its constituent parts.

diversified (dī-ver′si-fīed): varied or different in form, etc.

domestication (do-mes-ti-cā′tion): act of taming.

dominant (dŏm′i-nant): ruling; governing; prevailing.

dormant (dŏr′mant): sleeping; not active.

eject (e-jĕct): to cast out or expel.

elongated slit: a long slit.

emergence (e-mĕr′-gence): arising out of; pressing necessity.

envelope of the eggs (frogs): the gelatinous covering of the eggs.

essentials (es-sĕn′tials): those things that are necessary.

estuary (ĕst′ū-a-ry): an arm of the sea where the tide meets the current of fresh water.

evaporation (e-vap-o-rā′tion): conversion of a fluid into vapour.

ever vigilant: always watchful; not to be surprised.

exude (ex-ūde′): to sweat out; to issue forth.

flexion (flĕx′ion): act of bending.

Foot rot: a disease in the feet of the sheep, arising from damp pasturage.

fossilized (fŏs′sil-ized): to be changed into a fossil.

fossil remains: remains of animals or plants found in geological remains.

gamekeeper: the man employed to look after and care for the game on an estate.

gelatinous substance: a sticky substance.

gills (gills): the organs of respiration in the fish.

glairy mass: transparent gelatinous mass.

globular shaped: spherical; shaped like a globe.

glutinous secretion: tenacious sticky secretion.

gobble down: to swallow in great haste.

gulped (gŭlped′): swallowed eagerly.

habitual (ha-bĭt′ū-al): acquired by or according to habit.

haunts (häunts): resorts, places frequented.

hibernation (hī-ber-nā′tion): the lethargic, or state of sleep in which some animals spend the winter.

horrible whacks: cruel blows and beatings.

inaccessible (in-ac-céss′i-ble): very difficult to be got at or approached.

indefatigable (in-de-făt′i-ga-ble): not tired or exhausted by labour or fatigue; unwearied.

infested (in-fést′ed′): overrun with.

inheritance (in-hĕr′it-ance): that which descends from ancestors.

inherited (in-hĕr′it-ed): come by descent from ancestors.

inoculated (in-ŏc′ū-lāted): the act of budding or grafting: the communicating of infectious matter or poison, etc., from one body to another.

insatiable appetite: an appetite difficult to satisfy, requiring enormous quantities to satiate.

insipid in flavour: tasteless; not attractive.

isolated (īs′o-lāt-ed): alone; separated from others.

instinctive (in-stinct-īve): natural; the promptings of instinct.

intensified (in-tĕn′si-fied): increased in degree, or concentrated.

lampreys (lăm′prey): an eel-like fish, having a round sucking mouth.

leeward (lee′ward): that part towards which the wind blows.

lethargic (le-thär′gic): dull; drowsy.

lithe (līthe): pliant; flexible; capable of being easily bent.

logical (lóg′ic-al): reasonable.

lustrous (lŭs′troŭs): bright; shining; luminous.

marauder (ma-raud′er): one in quest of plunder or booty.

mechanism (of the jaws): the movement or action of the jaws.

membrane (mĕm′brāne): the skin that covers the separate members of the body.

metamorphosis (mĕt′a-mor′pho-sis): change of form or shape; transformation.

migrate (mī′grāte): to remove from one country, or state, to another part.

monasteries (mŏn′as-te′ries): houses of religious retirement.

muggy weather: moist, close weather.

natural trait: natural character or habits.

obtuse in shape: not sharp or pointed in shape.

ocellated spots: spots resembling an eye; spots of colour within or bordered by another colour.

opaque (o-pāque′): not transparent.

ovo-viviparous (ō′vo-vī-vĭp-a-roŭs): oviparous, but hatching the egg while within the body as some fish and reptiles do.

panic (păn′ic): increasing fear; a sudden fright without a cause.

panicles (păn′i-cle): the inflorescence and fruiting of the grasses, oats, etc.

paralysed (păr′a-ly′sed′): suspended functions; rooted to the spot and unable to move.

permanent (per′ma-nent): lasting, without change.

permanent pasture: land which is continued down to grass for many years.

perpendicular (per-pen-dĭc′ū-lar): extending in a right line from any point towards the centre of the earth; upright.

phases (phāses′): the different appearances or aspects of anything at different stages.

pivot (pĭv′ot)): literally a pin on which anything turns.

plantation (plan-tā′tion): a place planted with trees.

poacher (pōach'er): one who kills or takes game unlawfully.

pounce: to fall on and seize, as a bird of prey.

precarious (pre-cā'ri-ous): uncertain; likely to fail at any moment.

precocious (pre-cō'cious): mature before the proper time; too early development.

preponderate (pre-pŏn'der-āte): to outweigh or exceed in weight or influence; to incline to one side.

programme (prō'gramme): an outline or scheme of action.

prohibited (pro-hĭb'it'ed): forbidden.

proneness (prōne-ness): habitual disposition.

promptitude (prŏmpt'i-tūde): the habit of readiness; acting with immediate readiness.

propensity (pro-pĕn'si-ty): natural inclination; bent of the mind; tendency.

pugnacious (pug-nā'cious): quarrelsome, inclined to fall out and fight.

puncture (pŭnct'-ūre): to prick or pierce a hole.

pungent flavours: flavours which affect the organs of sense with a pricking sensation.

rasp (rasp): a species of coarse file.

repugnance (re-pŭg'nance): aversion; reluctance; dislike.

resuscitated (re-sŭs-ci-tāted'): recovered; brought back to life again.

retrieving *(re-triēv'ing)*: finding or recovering game.

reversal (re-vĕr'sal): to change over to the opposite.

reverts (re-vérts'): returns; falls back.

rudimentary (rū'di-mĕnt'a-ry): in the early stages of development.

scrupulously(scru'pu-lous-ly): with a nice regard to minute particulars; very exact.

secretive (se-crēt'īve): tending to hide or keep secret or hide.

self-reliance(sĕlf'-re-lī'ance): trusting to one's own powers; self-dependence.

shaggy (shăg-gy): rough; having long, rough hair or wool.

sheep are penned: the sheep are shut on a portion of a field by making a pen of hurdles.

Somaliland: a tract of land in East Africa, forming part of the shores of the Gulf of Aden.

spawn (spawn): the eggs of fish and frogs, etc., when deposited.

stagnant (stăg'nant): not flowing; not running in a current or stream.

stamina: the power of endurance; the constitutional strength.

stealthy stalking: the sly and secret way in which a cat, or beast of prey, stalks its victim.

stipule (stĭp'ūle): an appendage at the base of leaves, usually resembling a small leaf in texture and appearance.

stubbornness (stŭb'born-ness): the state of being stubborn; perverseness; obstinacy.

subordinate (sub-ŏr'di-nāte): in a lower order; of less value or importance.

succulent (sŭc'cu-lent): full of juice; juicy.

superfluous *(su-pĕr'flu-oŭs)*: more than is wanted; the overflow; the excess of anything.

swivel (swĭ'vel): a ring, pin, or staple that turns round on a pin or neck.

symmetrical-looking: well proportioned; well shaped.

tenaciously (te-nā'cioŭs-ly): holding fast firmly; keenly.

terrestrial (ter-rĕs'tri-al): pertaining to the earth; earthly.

tethered (tĕth'ered'): confined with a rope or chain.

theory (thē'o-ry): an exposition of general principles.

torpid (tôr'pid): dull; sluggish; inactive; benumbed.

traits (trāits): marked features or peculiarities of the character.

transformation (trăns'for-mā'tion): change of form or condition.

transmitted (trans-mĭt-ted'): the act of conveying or sending from one person or place to another.

triangular (trī-ăn'gu-lar): having three angles, or sides.

tropics (trŏp'ics): the regions on each side of the equator, the North being called the Tropic of Cancer and the South the Tropic of Capricorn.

turmoil (tur-moil'): unquiet; commotion; disquiet.

unadulterated (un-a-dŭl'ter-ā-ted): pure; unmixed with other matter.

unhampered (un-hăm'pered'): not fettered; not held back; not impeding the progress or motion.

untarnished (un-tär-nished'): unsoiled; unstained.

utilised (ū'til-īsed): made useful: turned to the most profitable account.

utilitarian (u-tĭli'-tā'ri-an): one who holds the doctrine of utilitarianism, the greatest happiness of the greatest number.

veterinary surgeon: one who is qualified to attend to the diseases and sicknesses of the domestic animals.

vitality (vī-tăl'i-ty): the principle of life.

wilderness (wĭl'der-ness): a desert; a forest.

zig-zag (zig'zag): having frequent short turns.

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